

PROGRESSIVE
MEDICINE.



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PROGRESSIVE MEDICINE.

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES,
AND IMPROVEMENTS

IN THE

MEDICAL AND SURGICAL SCIENCES.

EDITED BY

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VOLUME I. MARCH, 1899.

SURGERY OF THE HEAD, NECK, AND CHEST—DISEASES OF CHILDREN—
PATHOLOGY—INFECTIOUS DISEASES, INCLUDING CROUPOUS
PNEUMONIA—LARYNGOLOGY AND RHINOLOGY—
OTOLOGY.



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PREFACE BY THE EDITOR.

A SOMEWHAT intimate acquaintance with medical literature for a considerable period of time has convinced the editor of this publication that even if one has brought to him weekly the best medical literature of the world it is impossible to keep up with it in the sense of grasping its details and assimilating its really valuable practical facts in such a way that they can be applied at the bedside.

Original researches, disputations, records of epoch-making cases or discoveries come to one so fast and so voluminously that a life's work could be found by the physician who attempted to study all the views presented to him. The state of the progressive medical man of to-day is that of a man who, while hungry for food, has thrust upon him such a mass of pabulum prepared in so many forms by so many cooks that it is possible for him to get but a taste of many dishes from which he might obtain much pleasure and strength if he but knew their real value and design. Often the technical appearance of an article staggers his mental digestion, and he casts it from him as being too difficult a morsel for him to assimilate.

There are at the present time numerous "Annuals" or "Year-books" published with the object of recording in condensed form the greater part of the medical literature of the year, but in nearly all of them the process of "boiling down" has been practised without first sifting the useful from the useless, with the result that the physician has presented to him a mass, concentrated, it is true, but so varying in quality that the good can only be separated from the bad by a process as difficult as that needed for the utilization of the crude material. What the busy physician needs to-day is a well-told tale of medical progress in all its lines of thought, told in each line by one well qualified to cull only that matter which is worthy of his attention and necessary to his success. He needs an article which can teach him all that the master of a specialty

knows of the year's work, and he does *not* need an immense quantity of material which, however interesting it may be from its novelty, possesses no intrinsic merit.

It is with the object of presenting such readable and useful material that these volumes are published, and every contributor to the pages of PROGRESSIVE MEDICINE has been asked to say what he has to say in a narrative form, and, equally important, to place his hall-mark on the text, so that it will be a story which bears a personal imprint and will express not only the views of the authors cited, but the opinion of the contributor as well. The volumes contain personal narratives of medical advance, and this characteristic greatly increases their interest and value.

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PROGRESSIVE MEDICINE.

MARCH, 1899.

SURGERY OF THE HEAD, NECK, AND CHEST.

BY J. CHALMERS DA COSTA, M.D.

THE SURGICAL TREATMENT OF EXOPHTHALMIC GOITRE.

THE surgery of exophthalmic goitre, like the surgery of epilepsy, is in the experimental stage. Various operations have been devised, each founded on a different theory and each supported by amazingly gratifying statistics. Total extirpation is advocated by Doyen; Kümmell and many others perform partial thyroidectomy; Rydiger ligates the thyroid arteries; Kocher excises one lobe and one-half or two-thirds of the other lobe, and ligates three of the thyroid arteries; Jaboulay, of Lyons, believes in bilateral division of the cervical sympathetic; Jonnesco, of Bucharest, practises bilateral removal of the ganglia of the cervical sympathetic; Poncet does what he calls exothyropexy—that is, he makes an incision, exposes the thyroid gland, brings it into the wound and sutures it so that it will be exposed, hoping thus to bring about atrophy. Some operators seek to cause atrophy by dividing the thyroid isthmus; some inject iodine; many will not operate unless suffocation is threatened, and then merely perform tracheotomy.

The operations most worthy of consideration are those upon the cervical sympathetic and partial thyroidectomy. Operation on the sympathetic may consist of division of the cervical sympathetic or of excision of its ganglia. The advocates of such operations accept the views of Abadie as to the cause of Graves's disease, namely, that it is due to persistent irritation of the vasodilator fibres of the sympathetic and of their nuclei of origin, the goitre forming as a result of vascular engorgement of the thyroid.

Operations upon the Sympathetic. Jaboulay tried the operation of extirpation of the gland, and was not satisfied with it. He recalled the fact that stimulation of the sympathetic will cause exophthalmos and cardiac palpitation, and he concluded that Graves's disease might be due to irritation of the sympathetic. He determined to divide the nerves and thus cut off the hypothetical irritation. He claims that in nine cases the results were most satisfactory.

Jonnesco, instead of simply dividing the nerves, resects on each side of the neck the sympathetic ganglia.¹ He agrees with Starr, that the

¹ *Revue Chirurgicale*, November, 1897; Supplement.

mortality of thyroidectomy is over 17 per cent., and rejects thyroidectomy because of its higher mortality, because after its performance there is a tendency to rapid death from heart-failure, and because the reported successes of thyroidectomy have been largely in those cases in which the goitre long preceded the other symptoms; in other words, in atypical cases of Graves's disease. He has twice performed total bilateral resection with two cures. The operation is not easy, but he considers it safe and satisfactory.

The real value of operations upon the sympathetic is not as yet determined, although the reported results are alluring. The operation is certainly not free from danger. Faure's report shows this.¹ In one of his cases there was dangerous syncope during the operation. In another case he had finished one side without any alarming symptoms, but while operating on the other side the patient died suddenly from heart-failure. Faure thinks that the operation can be rendered safer by using ether instead of chloroform and by refusing to operate on both sides at one sitting.

There can be no doubt that the anæsthetic is a great danger in all goitre operations, and it would be well to take Kocher's advice and employ local *anæsthesia*.² Chipault says that in seventy-one operations upon the sympathetics there was not a death nor a serious complication.

The theory upon which this operation is founded has been practically abandoned by neurologists. Dana says it is an exploded theory. It was argued by Abadie and others that characteristic changes exist and can be demonstrated in the sympathetic ganglia; but identical changes have been clearly found in cases where Graves's disease did not exist. It is difficult to believe that a causative irritation could last for an indefinite number of years.

In estimating the value of the operation we must take into account the effect of the operation *per se*, for exophthalmic goitre may pass away after one of several operations, after a shock, after prolonged rest in bed, after medical treatment, or spontaneously. It is a disease which is associated with marked emotionalism and often with actual hysteria, and Jaboulay himself advises against operation if there is marked hysteria, because it will fail to cure. It has been pointed out by Doyen that the disease may be apparently cured by the operation and yet recur later.³

Combenante and Gaudier⁴ recently reported a case to the Paris Academy of Medicine in which resection of the sympathetic was followed by great improvement of most of the symptoms, though the goitre did not diminish in size. The authors think the operation should be done when

¹ *Revue de Chirurgie*, No. 11.

² Sixty-sixth Annual Meeting of the British Medical Association, July, 1898.

³ *Revue Chirurgicale*, November, 1897.

⁴ *Medical Record*, August 6, 1898.

tachycardia is very marked and persistent and when it is the only symptom or is linked simply with exophthalmos.

It is perfectly just to say that the value of the operation has not been proved; that it may prove fatal; that it may fail; that it should not be employed if the goitre is large, but it is proper to try it if the goitre is not very large and does not yield to rest and medical treatment and the patient refuses thyroidectomy.

Thyroidectomy is the most rational procedure, of which the mortality is about 7 per cent.¹ In Kocher's recent series of six hundred thyroidectomies there were fifteen cases of exophthalmic goitre with two deaths. Doyen maintains that thyroidectomy is safe.²

Even thyroidectomy does not always cure; for instance, Saenger's case became worse. In some cases the exophthalmos becomes worse. Kümmell reported 14 cases; 12 were cured and 2 somewhat improved. In one of his cases the remaining portion of the gland enlarged. Stokes highly approves of thyroidectomy, and Kocher considers the results satisfactory.³ J. Arthur Booth⁴ believes that Graves's disease is a primary neurosis, which is often aggravated by secondary thyroid intoxication. When this intoxication occurs we should remove one lobe of the thyroid gland. He tells us, further, that after operation, first the remaining lobe of the thyroid shrinks, next the nervous phenomena leave, next the pulse-rate and vasomotor condition improve, and finally the exophthalmos passes away. In his 8 cases 5 were cured, 1 died, and 1 was improved.

In coming to a conclusion as to the proper course of procedure in the treatment of exophthalmic goitre, certain facts are to be borne in mind:

A goitre may disappear spontaneously after an indifferent operation or after a nervous shock, hence it is difficult to estimate accurately the value of any method.

The patient will often recover under medical treatment and rest.

Surgical treatment is not certainly curative and is dangerous.

Disease of the thyroid gland is not the cause of Graves's disease, because the disease can exist without goitre, and may exist when the gland has been removed. Further, unilateral symptoms may occur, and we cannot believe that a pure intoxication can produce unilateral symptoms.

In many cases of goitre the symptoms of thyroid intoxication appear (tachycardia, dyspnoea, tremors, oedema, and enlarged thyroid).

The following conclusions seem justified by a study of the facts:

Treat most cases medically and by rest; if medical treatment fails consider the advisability of surgical treatment.

¹ J. Arthur Booth. *Medical Record*, August 13, 1898.

² *Revue de Chirurgie*, No. 97.

³ Sixty-sixth Meeting of the British Medical Association, July, 1898.

⁴ *Medical Record*, August 13, 1898.

Do not operate if there is great hysteria; if the gland is very large thyroidectomy will fail; if the gland is very small it will do no good to remove it.

If the symptoms are urgent, if the goitre is distinct but not excessively large, if it has relapsed under medical treatment, or if the patient refuses to submit to the necessary restrictions of medical treatment, perform thyroidectomy.

Take Kocher's advice, and do not promise cure, but realize that the patient may die or there may be a partial cure.

Do not remove the entire gland. Remove one lobe only, or one lobe and half or two-thirds of the remaining lobe. Even so-called complete thyroidectomies are not often really complete, as a remnant of the *processus pyramidalis* is usually left behind.¹ In addition to removing a part of the gland take Kocher's advice, and tie three of the four thyroid arteries.

Do not give a general anæsthetic, but produce local anæsthesia (Kocher). A general anæsthetic is very dangerous in goitre operations.

In advanced cases with threatened suffocation it may be necessary to do only tracheotomy. If the goitre is small, if the symptoms are marked and do not yield to rest and medical treatment, and the patient refuses thyroidectomy, we can perform bilateral resection of the cervical sympathetic ganglia.

GOITRE.

Very many goitres can be made to disappear by medical treatment alone. How large the number is which can be so cured is shown in a recent article by Theodore Kocher.² He states that 90 per cent. of the cases which come to his hospital in Berne are so much benefited by medical treatment that operation is not required.

Operation is required, according to Kocher, not only in cases which do not improve under medical treatment, but in cases in which cysts exist, in which there are several large and separate tumors, and in which there is even a possibility of the growth being malignant, and, he says, in any case dyspnoea is an indication for operation.³

The operation of strumectomy, or intraglandular enucleation, is the favorite method with many surgeons. According to Wormser, of Berne,⁴ this operation can be performed for unilocular cystic goitre, for isolated nodules surrounded by normal tissue if removal can be effected without great hemorrhage, and for morbid deposits in irremovable goitres. This

¹ Kocher, in *Correspondenz-Blatt für Schweizer Aerzte*, September 15, 1898.

² *Ibid.*

³ *Ibid.*

⁴ *Revue de Chirurgie*, April, 1898.

operation is not often used if there are multiple cysts; but, as T. J. Shepherd has said, a second cyst may be reached through the bed of another after the first has been enucleated.

The operation of enucleation is performed as follows: The gland is exposed by an incision, hemorrhage is arrested, the thin layer of gland tissue over the tumor is divided, and the white, smooth capsule of the tumor is exposed. If the tumor is solid, it is enucleated, the surgeon sticking close to the capsule. If it is cystic, the cyst is tapped, grasped with forceps, and enucleated. Bleeding vessels are ligated, the bed of the tumor is packed with iodoform gauze, and the wound is sutured, one or two sutures at the lower angle of the wound being left untied. At the end of twenty-four hours the packing is taken out and the other sutures are tied. This operation is very successful, T. J. Shepherd having performed it thirty times without a death;¹ but, as Wöllfler has shown, in this method there is danger of fatal hemorrhage, primary or secondary, and of sepsis, and, further, if an adenoma is removed, there are apt to be other adenomata present which subsequently enlarge. The operation is not so certain to bring about a permanent cure as is thyroidectomy.

Wormser² maintains that in the operation of thyroidectomy, as performed by Kocher, we are able to control hemorrhage, avoid doing damage to the nerves, and leave a piece of normal gland structure to prevent cachexia thyreopriva. There is very little danger of this cachexia arising. In Kocher's 1600 cases it arose only four times. Kocher says³ that usually, even in so-called complete extirpations, a remnant of gland is left, and often the processus pyramidalis remains.

Wormser⁴ advises the operation of thyroidectomy in the following conditions: In malignant tumor, acute and chronic strumitis, parenchymatous goitre, polycystic goitre, and goitre with multiple foci. It is contraindicated if no normal thyroid tissue remains.

The danger of the operation is greatly lessened since Kocher pointed out the advisability of operating without a general anæsthetic. A general anæsthetic engorges the veins and so increases bleeding, and, by producing subsequent vomiting, favors the production of reactionary hemorrhage. The retention of consciousness by the patient is very valuable to the surgeon. The former is from time to time asked a question while the latter is operating, and the tone of the patient's voice shows if the operator is near the recurrent laryngeal nerve. We should use as a local anæsthetic, either encaine, Schleich's fluid, or, as Kocher advises, a 1 per cent. solution of cocaine.

¹ London Practitioner, August, 1897.

² Revue de Chirurgie, April, 1898.

³ Correspondenz-Blatt für Schweizer Aerzte, September 15, 1898.

⁴ Revue de Chirurgie, April, 1898.

Kocher operates as follows:¹ He makes a curved incision over the goitre from side to side, the convexity of the cut being downward, this form of incision leaving the least noticeable scar. He separates the muscles in the middle line and does not cut them across, divides the outer capsule of the goitre, exposing glandular tissue, strips this capsule to either side, ligates any veins which were torn, draws the outer capsule of the goitre aside, and gradually inserts his finger beneath its under surface. He lifts the whole mass out of the wound, ties the inferior thyroid artery and vein, being careful to avoid the recurrent laryngeal nerve; the superior thyroid vessels are put on the stretch and divided, the isthmus is isolated and crushed with forceps, and thus all colloid material is squeezed out. In a complete extirpation he cuts through the tissues of the goitre parallel to the tracheal surface, leaving behind a portion of the posterior capsule, and so saving the recurrent laryngeal nerve. He operates aseptically rather than antiseptically, except in infected cases.

In some cases death occurs after thyroidectomy, the patient presenting the symptoms of Graves's disease. Paul has recorded such a case² in which he believes death resulted from the absorption of thyroid secretion.

We know from Bérard's studies that the absorption of thyroid secretion can produce such symptoms.³ He speaks of the condition as thyroid fever, and says that it is apt to arise the day after operation. Experimenting on rabbits, Bérard has produced thyroid fever with tetany and contractures by injecting thyroid secretion.

Thyroid fever may or may not be fatal. When it exists sudden death is liable to occur. Morphine is said to benefit the condition.

Kocher's statistics of thyroidectomy are wonderful, 1600 cases having been operated upon in his clinic. In his last 600 cases 18 were malignant, and 6 of these died; 11 were examples of strumitis, and 2 died; 15 were exophthalmic goitre, and 2 died. In 556 cases of colloid goitre there was 1 death, and this was due to chloroform, a mortality of 0.2 per cent.⁴

In malignant disease of the thyroid, operation is usually performed because of severe dyspnoea, and in malignant cases it is certain to become severe. The growth may be sarcomatous or carcinomatous. In each disease thrombi form in the veins and cells from the growth are widely disseminated. Thyroidectomy is not curative, as by the time the condition is recognized it is probably impossible completely to remove the growth. In a recent case of my own, in which dyspnoea was most urgent, an incision was made down to the capsule of the thyroid, the

¹ *Correspondenz-Blatt für Schweizer Aerzte*, September 15, 1898.

² *British Medical Journal*, January 1, 1898. ³ *Presse méd.*, December 29, 1897.

⁴ *Correspondenz-Blatt für Schweizer Aerzte*, September 15, 1898.

capsule was opened, and the growth rapidly enucleated. At some points the growth penetrated the capsule and there were thrombi in the veins. The hemorrhage was furious, but was controlled by forceps and ligatures; the wound was packed with gauze. The patient died in eight hours from shock. The growth proved to be sarcomatous. Reverdin has reported the removal of a sarcoma of the thyroid.¹ He operated because of dyspnea. The hemorrhage was excessive, and because of adhesions it was not possible to remove the entire mass. The patient died the next day. The veins were not thrombosed, but the carotid artery was invaded. Paralysis of the vocal cords from pressure, rapid emaciation, and dyspnea were present. Reverdin says that the signs of malignant tumor are dysphagia, radiating pain, edema of the chest-wall and upper part of the region over the sternum, and dyspnea. Dysphagia may occur in simple goitre; it is almost sure to occur in malignant goitre.

Operation is very dangerous. In Kocher's report we find that he operated on eighteen malignant goitres with six deaths.

SURGERY OF THE FACE, NECK, LIPS, AND TONGUE.

Actinomycosis of the Face and Neck. Human actinomycosis is a rare disease, though probably not quite so rare as has been supposed, thirty-nine cases having been published in Italy since 1882, and, adding Fantino's nine cases, we have forty-eight Italian cases in sixteen years.² Its most common point of origin is the lower jaw, the fungi gaining entrance to the alveolus. It first causes the formation of a tumor-like mass in the bone, resembling sarcoma; but later, when the infection with pus organisms occurs, an actinomycotic abscess is formed which ruptures into the mouth or through the skin of the face or neck. In an unreported case which was at the Jefferson Medical College Hospital, under the charge of Dr. Barton and myself, the patient was a mattress-stuffer by occupation. The condition was first mistaken for sarcoma and the man came to Philadelphia for advice. When first seen in this city sinuses had formed in the neck, the tissue about the sinuses being extremely hard; the discharge felt gritty and contained numerous granules, and Dr. Kyle found ray fungi by microscopic examination. This patient refused operation and was placed upon iodide of potassium. He was lost sight of after distinct improvement had been observed.

In another unreported case which was under Dr. Hearn's care in the Jefferson Medical College Hospital, the patient was a stableman. The disease did not begin in the bone, but started in the mucous membrane

¹ *Revue Méd. de la Suisse Romande*, December 20, 1897.

² *Riforma Medica*, April 20, 21, 22, 1898.

of the cheek. It formed a considerable, warty-looking mass, which was thought to be cancer and was removed by operation. It quickly recurred, involved the skin of the cheek, and soon formed a vast area of involvement. It was at this time that actinomyces were found in the discharge.

The third case of human actinomyces which I have seen was in a physician who finally came under the care of Dr. Keen and myself. The inner side of the arm was the part affected. The condition was not identified, and various diagnoses had been made, syphilis and tuberculosis having had the most adherents. Mixed treatment failed. Many operations had been performed without benefit, such as scraping, cutting away infiltrated tissue, and the use of caustics and the actual cautery. Finally ulceration took place into the axillary artery, producing a nearly fatal hemorrhage, but the patient plunged his thumb into the opening, had his hand tied in place, and was brought to the Jefferson Medical College Hospital nearly exsanguinated. The artery seemed to be diseased, so it was not ligated, but the bleeding was arrested by forepressure. At this time the discharge was first examined, and it contained whitish granules which were not gritty. Dr. Kyle found ray fungi in portions of the granuloma, but never found them in the discharge. A few weeks later Dr. Keen performed a most extensive operation, removing infiltrated subcutaneous and intermuscular tissue from the elbow to the shoulder. The lymphatics and muscles were not involved, but the skin was penetrated by several sinuses, each surrounded by hardened tissue. The disease affected the fibro-areolar tissue, subcutaneous and intermuscular. The patient was cured and has been well for over two years.

Lambert¹ has recently reported a case of cervico-facial actinomyces. The patient developed an alveolar abscess which was incised, and later it was found necessary to extract a tooth, though the discharge of granular sanious pus continued. Examination of the granules showed that the case was one of actinomyces. A cervical fistula developed. This patient was shown to the Société Centrale de Médecine du Nord. Fautino has reported nine cases, one of which was fatal.²

In every case of supposed malignant disease we should consider the possibility of the disease being actinomyces. Billroth stated, several years ago, that in a series of cases of supposed inoperable sarcoma brought to his clinic, 10 per cent. were cases of actinomyces. The diagnosis is often difficult. The fungus usually enters with the food (Syme), an abrasion of mucous membrane or a carious tooth permitting its entrance. In some cases the spores are taken up from a mucous surface and deposited in a distant part, as, for instance, the brain. The skin can be affected by direct inoculation, or secondarily as a deeper area

¹ Nord medical, July 15, 1898.

² Riforma Medica, April 20, 21, 22, 1898.

approaches the surface. We should inquire into the occupation and habits of the individual. As the fungus grows upon grain, we should find out if the patient has been in the habit of putting straw in his mouth. In our first case the man's occupation was stuffing mattresses with straw. In Dr. Hearn's case the patient was a stableman and frequently chewed oats and straw. Dr. Keen's patient was a physician, and the source of infection could not be traced. Cultures are very difficult to obtain. The disease can be developed in animals by intraperitoneal inoculations. The yellow granules contain the fungi and so do the granulations, and in one of our cases they could be found only in the granulations. The disease may affect the lungs, viscera, brain, bones, antrum, mammary gland, subcutaneous tissue, and skin.

An actinomycotic tumor is without pain, feels hard, but grows more slowly than a sarcoma. The lymphatics are not enlarged. After a time infection is apt to occur with pyogenic cocci and many foci of pus form, reaching the surface, and several or many sinuses form.

The sinuses are usually surrounded by very dense tissue and the skin about them is violet in color. The discharge is ichorous or sanious and contains whitish or sulphur-yellow bodies which are visible to the naked eye and feel gritty or greasy to the touch. It has been said that in man they feel greasy (Parker Sym's), but in two of our cases they were gritty. In our third case bone was not affected, and they were greasy. It is often hard to find the actinomyces. Fautino,¹ in one case, looked for them often, but could not find them for three months. He says they are more easily found early in the case and when the case is amenable to treatment. The diagnosis must be made from syphiloma, sarcoma, cancer, chronic inflammation, and tuberculosis. When pyogenic infection occurs the mass becomes painful, the skin above it becomes dusky red, and the growth enlarges rapidly.

An area of cutaneous actinomycosis is granulomatous, the surface of yellow color with undermined edges, the skin around it of a violaceous tint, and the discharge of the ulcer contains yellow, pinhead granules.

The treatment consists in extirpating the mass if possible. If this is not possible sinuses should be curetted, ulcerations scraped, and infiltrated skin cut away. In some cases the internal administration of iodide of potassium is curative. In some, local injections of iodide of potassium are said to do good. In our first case operation was refused and the patient, while under observation, improved distinctly from the administration of iodide of potassium.

In the second case, Dr. Hearn did two extensive operations, but the disease returned, and iodide gave no relief.

¹ *Riforma Medica*, April 20, 21, 22, 1898.

In the third case iodide of potassium had been tried under the supposition that the condition was syphilitic, but it did no good. The entire mass was excised and never returned. After the last operation an attempt was made to give the iodide, but the patient could not tolerate it, and was given hydriodic acid instead.

Tubercular Glands of the Neck. Tubercular glands of the neck are most common between the third and the fifteenth years. They most commonly occur in those predisposed by heredity, but may be met with in persons who have no ascertainable tubercular history. They begin often as non-tubercular adenitis, the inflammatory area becoming tubercular because it is a point of least resistance. Miller¹ says that there is often a pretubercular stage, simple adenitis being finally replaced by the tubercular form. Sometimes glands enlarge because tubercle bacilli have been deposited in them and an effort is being made to destroy the invaders. The bacilli usually reach the cervical glands from some point of disease about the mouth which permits bacilli to enter the lymphatics, and this internal trouble may be dental caries, chronic pharyngitis, or enlargement of the tonsils. The enlargement usually begins in the submaxillary or sterno-mastoid glands of one side; other glands in the neck are subsequently involved, and the other side of the neck not unusually becomes affected also. The swellings, when first seen by the surgeon, have usually existed some time, and the patient, as a rule, gives a history of having had at first an attack of subacute adenitis. The glands are neither tender nor painful, are freely movable and isolated, firm, and not larger than an almond.

Miller² divides the cervical glands into six groups: The occipital, the mastoid, the parotid (superficial and deep), the submaxillary, the sterno-mastoid (upper and lower), and the supraclavicular. This is, obviously, a very convenient arrangement for diagnostic purposes. The same observer tells us that it is important, when dealing with an enlarged gland, to know what area is drained by its lymphatics and to see if there is any causative lesion in that area. He states that the lymphatics of the occipital glands come from the posterior part of the scalp; those of the mastoid glands from the scalp and ear; those of the superficial parotid from the front of the scalp, forehead, temple, and external meatus; those of the deep parotid from the orbit, nose, pharynx, middle ear, and teeth of the upper jaw; those of the submaxillary gland from the cheek, lips, mouth, and lower teeth; those of the upper sterno-mastoid from the tonsil, pharynx, œsophagus, and larynx; those of the lower sterno-mastoid from the deeper structures, and these glands are usually involved secondarily to the upper ones; those of the supraclavicular from the intrathoracic and axillary regions.

¹ Scottish Medical and Surgical Journal, December, 1897.

² Ibid.

When glands enlarge in the neck we should examine the area from which they receive lymph and treat any diseased condition which exists there. If we fail to do this we will not cure the disease, for reinfection will be certain to occur. If the glands are firm and not large, try medical treatment (ichthyol injections and the internal use of the iodides, tonics, nourishing diet, and cod-liver oil). Hendrix¹ maintains that if the glands are fused, but uncased, the use of the x-rays causes them to become movable and smaller; but if caseation has occurred the rays irritate. It would be well if these observations were confirmed or set aside by further studies. Hammerschlag² injects iodoform emulsion (5 to 10 per cent.), preceding the injections by a course of tonics. In some cases he throws the emulsion to the periphery of the gland, in other cases into the gland. He throws in 1 to 2 c.c. on one side of the neck, and a week later the same amount on the other side. He uses local anaesthesia and claims most gratifying results in large-cell hyperplastic glands. If, in spite of treatment, the glands remain stationary or increase in size, he removes them completely. Incomplete removal may lead to the general diffusion of tuberculosis. If a gland is caseating we are to insert a hypodermatic needle, draw out the fluid, and inject iodoform emulsion. This process can be repeated several times. If many glands are caseated, we can make an effort to remove them, but it is safer and wiser to make several small incisions, curette, and then pack with iodoform gauze. If the skin above a gland is infiltrated, it must be cut away when the gland is opened, for if it is left an ugly depressed scar will form.

Tuberculosis of the Parotid Gland. This is a rare disease, or, at least, one which is very rarely recognized. It may be confounded with chronic inflammation and sclerosis caused by a calculus in the duct. I have on several occasions seen tuberculosis of the lymph-gland in the parotid secondary to tubercular disease of other glands of the neck. On one occasion I removed such a gland, and on another occasion assisted Dr. Keen in removing one. Parent³ has discussed primary tuberculosis of the parotid gland, and his views are as follows:

This disease may appear in either a confluent or a disseminated form, and the bacilli may reach the gland by Steno's duct, by the blood, or by the lymph. The points from which infection are apt to arise are carious teeth, the tonsil, and inflamed mucous membrane of the gums. The disease is difficult to recognize clinically, and it can only be certainly recognized by bacteriological and histological studies. It affects adults more commonly than children, comes on insidiously, and progresses slowly.

¹ La Polyclinique, May, 1898.

² Deutsche medicinische Wochenschrift, December 23, 1897.

³ Gazette hebdomadaire de Médecine et de Chirurgie, September, 1898.

The treatment consists in extirpating the tubercular area or, in the disseminated form, extirpating the entire gland.

Ligation of the First Part of the Subclavian Artery. The textbooks advise against this operation. Erichsen considered the operation "bad in principle" and thought it should never be performed. Secondary hemorrhage is the cause of the high mortality, and Souchon has collected sixteen operations, fourteen on the right side and two upon the left, and every one was fatal. Since Souchon's table was published, Halsted, of Baltimore, has tried the first part of the left subclavian and extirpated an axillary aneurism, his patient recovering. In view of the better results now rendered possible by antisepsis, secondary hemorrhage should be less common, and, again, the introduction of the Ballance and Edmunds stay-knot enables us to approximate, but not divide, the inner and middle coats. Under such improved conditions the operation is justifiable. The use of broad ligatures which will approximate the coats, without dividing them, is not new, for Crampton and Scarpa tried them; but before the days of antisepsis they always failed, and they never used the double ligature tied in a stay-knot. Occasionally the stay-knot is not quite satisfactory and permits of re-establishment of the blood current.

B. Farquhar Curtis has reported a brilliantly successful case of ligation of the first part of the right subclavian artery.¹ The patient was a Swede, forty-two years of age, who noticed a tumor above the clavicle one year before admission to the hospital. On admission it was evident that the aneurism involved the third part of the subclavian artery. Curtis operated upon him. Two ligatures of chromicized catgut were cast about the artery an eighth of an inch from the thyroid axis, and they were tied by the method of Ballance and Edmunds. Twenty-four hours after the operation circulation was re-established in the fingers. The patient recovered, and is well four months after the operation.

In a debate in the New York Surgical Society upon this notable case,² Stimson maintained that, whereas such a ligature does not divide the internal and middle coats, the result is the same, for it causes absorption of the coats under the ligature.

Dawbarn had much doubt if the stay-knot had aided in the good result.

Curtis, in answer, said that the change produced in the vessel wall is slow if the stay-knot is used, and if sepsis occurs the danger is much less than if the old form of knot is employed.

Tracheotomy Under Local Anæsthesia. If tracheal stenosis exists a general anæsthetic is dangerous and may produce suffocation, and it is desirable, whenever possible, to use a local anæsthetic. In a case of

¹ *Annals of Surgery*, April, 1898.

² *Ibid.*

syphilis of the larynx in which I assisted Dr. Jones in performing tracheotomy in the Jefferson Medical College Hospital, eucaine was injected, and the operation was easily completed and with very little pain. In fact, the trachea is not very sensitive, even if no anæsthetic is employed. I have several times been struck with this fact when treating cases of cut throat.

Fränkel¹ is a believer in the value of local anæsthesia if it becomes necessary to perform tracheotomy for stenosis of the larynx. He has operated twenty-three times under cocaine anæsthesia. In four of his cases he first gave a little chloroform, and then suspended chloroform and injected cocaine. He injects a 20 per cent. solution at two points, or a 10 per cent. solution at four points, waits a short time, and then operates (he uses three-fifths of a grain of cocaine). In children he uses a 10 per cent. solution. It does not seem wise to use so much cocaine, as satisfactory anæsthesia can be obtained with a 4 per cent. solution if the fluid is injected into the Malpighian layer of the skin by the method of Wyeth. It is useless and dangerous to inject cocaine into the subcutaneous tissue. Eucaine is safer than cocaine and is satisfactory in tracheotomy. Schleich's fluid gives satisfactory anæsthesia.

Carcinoma of the Lip. The operation so often performed, in which the growth is removed by a V-shaped incision and nothing else is taken away, is not sufficiently radical. Lymph-glands become infected in cancer of the lower lip, and as in removing a carcinoma of the breast we take from the axilla all of its contents, except vessels and nerves, so when we remove a cancer of the lower lip we should remove the anatomically related lymphatic glands and the fibro-areolar tissue in which they lie. The primary growth should be completely removed, the cut being carried wide of it and into healthy tissue. If the growth involves less than one-half of the lip the V-shaped incision will be suitable. If the tumor involves more than one-half of the lip we should remove the entire lip and restore it by a plastic operation. After the lip wound has been sutured the neck is operated upon. The most convenient incision is that described by Teske,² a vertical cut from the chin to the thyroid cartilage and a cross-cut on each side along the lower margin of the body of the inferior maxillary line.

The glands first affected in cancer of the lip are the submental, the submaxillary next, and, finally, in advanced and inoperable cases, the cervical glands. The upper lip is very rarely the seat of cancer, and, when it is, glandular infection is apt to be late. When it occurs it is first noted in the submaxillary lymphatic glands.

¹ Berliner klinische Wochenschrift, June 6, 1898.

² Centralb. für Chirurgie, No. 4, 1898.

Treatment of Epithelioma of the Face by Caustics. The general public lean strongly to this method. It is very popular with charlatans who do not dare to operate, and hence advertise to cure "without using the knife." There is no doubt that it is possible to cure epithelioma by caustics, and the treatment has been used since the sixteenth century. It is very painful, requires a considerable time to succeed, does not go so wide of the disease as does the knife, leaves much deformity, and does not remove the associated lymph-glands. In the Surgical Out-patient Department of the Jefferson Medical College Hospital during the course of ten years caustics were tried upon a number of cases, and I came to the conclusion that recurrence was much more rapid and certain after removal by caustics than after removal by the knife. Nevertheless, in some small rodent ulcers the results are excellent. Every now and then we encounter a patient who refuses to submit to an operation, and in some of these patients, if the ulceration is superficial and there is a fair chance that glands are not as yet involved, it is justifiable to use caustics. Arsenous acid is the material usually employed. Marsden's paste, which has enjoyed considerable reputation, consists of 2 parts arsenous acid and 1 part of mucilage of acacia. Hermet¹ made a report to the Paris Dermatological Society, in which he advocated treating some cases of cancer of the skin of the face with arsenous acid, after the method of Czerny.

Czerny's method is as follows: Make three solutions of arsenous acid in equal parts of water and ethyl alcohol. The weaker solution is of an arsenical strength of 1 to 150. The weak solution is applied to the ulcer every day until a seal or crust forms. The pain is apt to be severe, and it may be necessary to give morphine hypodermatically before applying the arsenic. For a time the medium solution is applied daily to the seal, and finally the strongest solution is used.

In Hermet's case the growth was completely destroyed by the third month, and cicatrization was complete a month later.

Wounds of the Thoracic Duct. The thoracic duct or a radicle of it may be injured by a stab, a bullet, or during the performance of a surgical operation upon the left side of the neck. When the duct is injured there is usually an immediate flow of chyle, but the flow may not appear for several hours or even days (Schwinn's case), and the surgeon will not suspect the injury until the flow of chyle occurs. If the flow of chyle continues, the patient grows very weak, rapidly loses flesh, and finally dies. It used to be thought that all such cases died, but it is now known that recovery may occur. Keen's case recovered after packing. Schwinn's case, in which a large radicle was divided, recov-

¹ *Lancet*, March 26, 1898.

ered after clamping the radicle. Lyne's case¹ was saved by packing with iodoform gauze. H. W. Cushing² has collected seven cases from literature, all of which recovered. In two of the cases sutures were applied at the time of the accident, and in the other cases, when the injury was discovered, packing was used or clamps were applied. Cushing reports a case in which the duct was injured while he was removing the supraclavicular glands. He sutured the duct with fine silk, inverted the edges, and his patient recovered. He reminds us that the duct may reach to a height of 5.5 cm. above the sternum, and maintains that when operating near the duct all visible lymphatics ought to be tied. Cushing considers suture the ideal method of treatment, but says if it is impossible to suture, and the lymph vessel is large, treat it as if it were the chief and only duct. Put a provisional ligature on the proximal side of the wound and pack with gauze. We thus have a safety-valve which permits the escape of chyle if pressure becomes great and collateral lymph circulation is established slowly.

Hare-lip and Cleft-palate. The question is constantly propounded, When shall an operation for hare-lip be performed? A child with single hare-lip can suck well unless there be also a cleft-palate, in which case it cannot suck, and must be fed with a spoon. In every case in which a child cannot suck, have food given in sufficient quantity with a spoon, because it is highly important that the patient be well nourished when the operation is performed; otherwise, the stitches will cut out, the deformity will become worse than ever, and correction will be more difficult. R. W. Murray advises operation in the fourth week.³ Mumford thinks the best time to operate is from the sixth to the eighth week,⁴ as does Heath. We prefer to operate between the third and fourth month; but nothing is to be gained by further delay unless the child is ill-nourished, in which case we may wait while we feed the patient into strength and resisting power. It is not wise to wait until teething begins, because at this period the health will be much disturbed, and operation should not be performed during the existence of gastro-intestinal or bronchial disturbance.

If a cleft-palate exists it must not be operated on so early. The hare-lip is operated on first. The persistent pressure made by the closed lip helps to lessen the gap in the growing bone. It used to be the custom to postpone operation upon the palate until the fourth year, or even much later, but Edmund Owen has shown the illogical nature of such a delay. If the operation for cleft-palate is postponed until the patient has learned to talk, the speech defect will never be corrected by any surgical proceed-

¹ Medical Register, August 15, 1898.

² Annals of Surgery, June, 1898.

³ Liverpool Medico-Chirurgical Journal, January, 1898.

⁴ Mumford. Boston Medical and Surgical Journal, March 3, 1898.

ure. We believe, with Owen, that a cleft in the soft palate only may be operated upon during the first six months of life ; but a cleft involving the hard palate should be operated upon during the second year. Murray¹ operates on the cleft when the child is twelve months old. He has operated during the first few months of life, but advises against doing it so early, because the tissues are friable, the uval halves are too minute to permit of the formation of a uvula, and the space to work in is very small.

Mumford's rules for the treatment of hare-lip are very useful.² They are as follows :

1. Babies with hare-lip are not of necessity feeble at birth, and can be kept at the normal standard by proper feeding.
2. The field of operation should be kept clean with antiseptic washes before operation.
3. Operate from the sixth to the eighth week.
4. Do not slash with scissors, but cut and trim with a knife.
5. Free the upper lip thoroughly from the jaw.
6. Anchor the nares with shotted wire.
7. Use no pins or heavy outside sutures.
8. Use *crêpe lisse*, not surgeon's plaster.
9. Leave the heavy inside stitches for six days.
10. After operation give special attention to the care of the bowels and proper feeding.

I am accustomed to pare the lip with a sharp tenotome or cataract knife, separate the upper lip from the jaw with scissors curved on the flat, and if the ala of the nose is flattened pull it toward the septum by means of a silver-wire suture or a button suture, as suggested by Murray.³ Mumford's plan of anchoring the nostrils with shotted wire is excellent. I have usually sutured by deep silver wire or silkworm-gut sutures, going almost to the mucous membrane, and closed the mucous membrane with a fine silk suture. Recently Mumford's suggestion has been used with advantage. I usually lay a single thickness of gauze over the lip, the gauze being long enough to reach well out upon each cheek, and paint this gauze with iodoform collodion.

In dealing with a double hare-lip I believe it is best to remove the intermaxillary bone, for if it is left it is apt to undergo necrosis. It is a good plan to remove it by a subperiosteal operation a week before operating on the lip. Murray truly says⁴ that if we keep the bone the operation on the lip will be difficult and the bone will act as a wedge, preventing closure of the anterior portion of the palate. He says that

¹ Liverpool Medico-Chirurgical Journal, January, 1898.

² Boston Medical and Surgical Journal, March 3, 1898.

³ Liverpool Medico-Chirurgical Journal, January, 1898.

⁴ Ibid.

the removal of the bone leads to flattening of the upper lip, but flattening will not be great if the bone is removed by a subperiosteal operation and if one side of the lip be operated on at a time.

Operate on a cleft in the hard palate before the child is two years of age, and operate when the child is in the best of health. Edmund Owen¹ tells us never to operate unless the child's health is good, to remove carious teeth, adenoids, and enlarged tonsils before operating, and to operate if possible in fine weather, so the patient can soon get out of doors.

The operation preferred by Owen, and one which has proved eminently successful in his hands, is performed as follows: Place the patient on his back with his head hanging over the end of the table, give chloroform, and open the mouth with Smith's gag. Remove a *continuous* strip of mucous membrane from each margin of the cleft, make an incision three-fourths of an inch long on each side, just internal to the molar tooth. Stop bleeding by pressure. Separate the periosteum with a raspator. Separate the velum from its fibrous attachment to the bony plate, using a pair of scissors bent on the flat almost to a right angle, and cutting through the nasal mucous membrane. Suture with silver wire, beginning back of the incision and fastening by means of torsion forceps.²

The Trendelenburg position will allow the blood to run into the nasopharynx as efficiently as the position Owen uses, and will, I believe, be as satisfactory for the surgeon and safer for the patient.

If the operation fails a second operation will be more difficult; but, as Owen says, the failure of the first does not preclude a second.

Carcinoma of the Tongue. Carcinoma of the tongue is by no means a rare disease. Frequently it is preceded by a persistent causative irritation, as, for instance, a jagged tooth. Dennis has cited its occurrence in workmen who hold nails in the mouth. It not unusually follows a chronic inflammatory condition, such as psoriasis or ichthyosis, and, I believe, can follow a syphilitic lesion, such as leukoplakia.

In the evolution of this growth there is usually a prolonged period during which the epithelial cells are subjected to irritation, a precancerous stage. If we recognized these facts we should be able to save many from one of the most fearful of diseases, a disease in which the glands become implicated, the floor of the mouth and tonsils involved, in which the pain is great, the breath fetid, the saliva flows profusely, and in which speech, mastication, and swallowing are greatly interfered with. As Jacobson says, "This most important stage is, from the position of the organ which it attacks, peculiarly under our eyes and lies open to our

¹ Edmund Owen. *Lancet*, January 29, 1898.

² *Ibid.*

examination and detection; yet how frequently it is overlooked." The growth, as a rule, originates at the tip or sides of the tongue and rarely in its posterior portion. The common form progresses rather rapidly and, if uninterfered with, produces death within eighteen months. The rarer form, to which attention has been directed particularly by Wölfer, may remain non-progressive for many years.

In a case of cancer of the tongue the surgeon must decide if operation is justifiable. In some cases it is clearly out of the question to hope for any benefit from even the most radical removal. In other cases removal promises palliation of the condition and prolongation of life, sometimes even cure.

Butlin's table is of great importance.¹ The results are better than those usually given, and prove that lingual carcinoma can be cured by operation. In his list 16 per cent. of hospital cases and 26 per cent. of private cases were cured.

TABLE I.—*Hospital Cases.*

	Cases.
Died of operation	9
Lost sight of	7
Recurrence <i>in situ</i>	8
Affection of glands without recurrence	16
Died later, cause unknown (probably cancer)	4
Well within three years after operation	2
Well more than three years after operation	7
Total	53

TABLE II.—*Private Cases.*

	Cases.
Died of operation	1
Recurrence <i>in situ</i>	10
Affection of glands without recurrence	12
Died of other causes than cancer of the tongue within three years	4
Well within three years after operation	9
Well or died of other causes more than three years after operation	13
Total	49

Barker estimates that 10 per cent. of cases operated on are cured. Jacobson thinks that permanent recoveries are rare, but believes that a proper operation will prolong life for six or eight months.

We ought not to operate if the floor of the mouth is extensively invaded, or if the tonsil or pharynx is involved, or if the glands of the neck are very large and adherent or broken down. In considering what form of operation should be adopted it is well to bear in mind certain facts:

Glandular infection usually exists when the carcinoma is diagnosed.

¹ Hunterian Lecture for 1898, in British Medical Journal, February 26, 1898.

Heidenhain has pointed out that tongue cancer is particularly malignant, because the constantly repeated contractions of the lingual muscles force cancer cells to a distance from the primary seat of disease, along the lymphatic vessels.

Kuttner, of Tübingen, has shown that a certain amount of lymph from one side of the tongue reaches the other side of that organ and certain glands of the neck, and these views would indicate that only the most radical procedure is likely to be of benefit.

The glands of the neck should certainly be removed, whether or not they show obvious signs of disease, in advanced cases. The free removal of the glands has enabled Butlin to obtain such improved results. As both sides of the tongue are more or less involved, the glands should be cleared out from both sides of the neck, and we should remove the deep cervical, submaxillary, and deep glands just above the sternum (Kuttner, of Tübingen). Butlin removes the contents of the anterior triangle, taking out the connective tissue and glands in one piece, removes the submaxillary gland, searches between the muscles in front for one or two deep-seated glands, and at a second operation removes the submental and parotid lymph-glands.¹

How much of the tongue should be removed? In view of the tendency to rapid dispersal of the carcinoma cells along the lymph vessels, and even to the opposite side of the tongue, we believe that the best results will be obtained by removing the entire tongue.

In partial removal the chances are great that infiltrated areas are left behind. The more of the tongue that is removed, the greater is the chance that the disease has been extirpated. Just as in carcinoma of the female breast we always remove the entire gland, so in cancer of the tongue we should remove the entire tongue. It is but just to say that the weight of surgical opinion is against this rather extreme view. Butlin maintains that removal of the entire tongue is not often necessary, and in only one of his successful cases was this procedure carried out. If the disease is on the border he removes half of the tongue to a point one inch beyond the disease. In other cases he removes, with the cancer, three-fourths of an inch of apparently healthy tissue.²

If we decide to remove the entire tongue, we have our choice of several procedures. The Whitehead method permits of the removal of the entire tongue, though it is necessary to make a separate incision in the neck to reach glands; in view of the fact that both sides of the neck should be opened to remove glands, we do not think it an objection that in this operation the neck is not opened on one side as it is in Kocher's proceeding. We believe Whitehead's operation of removal to be satisfactory,

¹ British Medical Journal, February 26, 1898.

² Ibid.

as the neck can be opened later, the secretions of the mouth will not enter the wounds made in the neck, and these will heal rapidly. Of the external operations, we would recall Senn's statement that Kocher's operation does not expose the base of the tongue as freely as the Regnoli-Billroth method. This latter method permits of the most radical removal, and, if the strength of the patient justifies it, and the growth is extensive and the floor of the mouth is involved, it should be employed.

SURGICAL OPERATIONS ABOUT THE CHEST.

The Lung. The surgery of the lung has, of late years, made notable steps in advance because of improved methods of arresting hemorrhage and of locating foreign bodies and areas of tuberculosis and because, also, of increased anatomical knowledge regarding the lung. The conditions which may permit of operation are wounds, foreign bodies in the lung or bronchial tubes, abscess, gangrene, bronchiectasis, tuberculosis, tumors, hydatids, and actinomycesis.¹

The anæsthetic is a great danger in lung operations. As a rule, chloroform is given, but in some cases ether can be used, though chloroform produces less cough and is less liable to cause asphyxia. Of whichever one selected, as little as possible should be given. In fact, when the lung is reached the administration can be suspended, for lung tissue is not sensitive. We have verified this statement of Fowler in several cases. In some cases it is evident at once that no general anæsthetic would be borne, and in such cases the superficial parts may be anæsthetized by chloride of ethyl spray or by injections of encaine or Schleick's fluid.

Wounds of the Lung. The proper course of procedure in a wound of the lung is often a matter of grave uncertainty. It is true, as Péan claimed, that wounds made by sharp or blunt instruments or by small or medium-sized bullets are often recovered from, the wounds frequently healing without serious reaction, and suppuration being not unusually avoided. In fact, it is not so much the injury to pulmonary structure which causes apprehension, but rather the injury to great bloodvessels and important structures outside of the lung.

The view generally held by surgeons is that we must not be in haste to incise and explore, as many cases will recover without interference, and if bleeding has ceased the chest should not be opened unless pus forms. In the Spanish-American war Dr. Senn was struck with the satisfactory course of patients who had been shot through the lung with

¹ Kohler. *Gazetta degli Ospedali*, May 3, 1898.

a Mauser bullet, and treated by aseptizing the surface and sealing the wound hermetically.¹

Lucas-Championnière has denounced the haste shown by some surgeons to operate, because most cases of hemothorax will get well if the side of the chest is immobilized. Réclus advocates operation for pulmonary hemorrhage only in cases in which the bleeding continues in spite of sealing of the wound, rest and immobilization of the chest-wall, the patient being in danger of death from cardiac paralysis, paralysis of the diaphragm, or the great amount of blood in the pleural sac.

Tuffier² has reported seven cases of wounds of the lung in which the pleural cavity was opened and the lung sutured, and all of these cases recovered. Köhler³ considers that operation may be justifiable in wounds.

I believe, with Réclus, that operation is indicated in a few, but in only a few, cases. In most cases the hemorrhage will cease, but not from intrapleural pressure, which Pagenstecher shows is insufficient to arrest hemorrhage. The case is treated by aseptizing the surface, sealing the wound, and strapping the side of the chest. If hemorrhage does not cease, or if it recurs again and the patient seems likely to die, we must operate. It is very dangerous, but offers the best chance. Tuffier's cases show that operation may be very successful. In some cases vessels have been ligated, in other cases a wound has been plugged with iodoform gauze. It is possible to suture the lung for hemorrhage.

In a case reported by the author none of these means could be employed. This case is a remarkable one, and I will briefly refer to it.⁴ This man had been shot with a revolver eleven days before admission to the hospital. He was much collapsed, but was treated at his home for a time. As he grew worse, the physician in attendance sent him to the Jefferson Medical College Hospital, and on admission he was found to have an effusion in the pleura (hemothorax), the line of dulness in front and to the side being just below the nipple line. A few hours after admission he went into collapse, and it was found that the line of dulness had moved up to the second rib. It was evident that this patient had had a secondary hemorrhage, the pleura now containing the product of two hemorrhages, and it was evident also that he would die if something were not done at once.

He was taken to the operating-room; a little ether was given; a tube was inserted into the median basilic vein and hot normal salt solution was allowed to flow in. (During the operation two quarts were given.) The surface of the chest was sterilized, a U-shaped flap was cut and

¹ Senn. *Journal of the American Medical Association*, July 9, 1898.

² *Medicine*, December, 1897.

³ *Gazetta degli Ospedali*, May 3, 1898.

⁴ J. Chalmers Da Costa. A Case of Gunshot Wound of the Lung. *Annals of Surgery*, January, 1898.

turned up, and a bullet wound was found between the fifth and sixth ribs. About six inches of each of these ribs was resected. On opening the chest, there was a fearful gush of blood mixed with air, and the patient coughed violently. The wound was partly plugged with the hand and the blood was allowed to run out more slowly. The blood, which was caught in a pail, was free from clots and measured one gallon and one-half pint. This enormous amount of blood resulted from the primary and secondary hemorrhage. It was found on examination that the lower lobe of the lung was lacerated, sloughing, and bleeding freely. Ligatures and forceps would not hold in the damaged tissue, and in any case the bleeding area was too extensive to have been successfully treated by such a method. It was useless to pack gauze against the bleeding point, as to do so would simply push the lung away and would not stop the bleeding. The lung was grasped with the hand and the hemorrhage arrested, the pleural cavity was packed with gauze around the lung to afford a base of support and to prevent the lung from receding, and iodoform gauze was then packed firmly against the sterile gauze and the damaged area. The bullet was not sought for. The ends of the gauze projected from the wound, and the flap of soft parts was sutured in place.

For several days after operation the patient was delirious and gravely ill, but by the time a week had elapsed he was clearly out of danger. The packing was removed five days after the operation, and no bleeding occurred. Several times during convalescence great sloughs of lung tissue were removed from the pleural cavity.

At the present time, almost a year since the report in the *Annals of Surgery*, and eighteen months since the operation, the man is strong and well. The large suppurating cavity which followed the operation is greatly shrunken, the chest-wall having sunk in to a considerable extent. We were in doubt for a time as to the best course to pursue in treating this cavity. Some advised free rib resection; others, among them Dr. Keen and Dr. White, advised against it. The present condition justifies our conservative course, for the great cavity has become a narrow sinus which promises to heal.

In reviewing this case it seems certain that he would have died if operation had not been done to arrest the hemorrhage.

Foreign Bodies in the Bronchus. The removal of foreign bodies from a bronchus is a difficult and dangerous undertaking. In some cases, after the performance of a low tracheotomy, the foreign body may be expelled; this failing, it may be reached and extracted. In cases in which the body is not found after tracheotomy it may be expelled from an open tracheotomy wound during a fit of coughing. Recently, in a case in which I assisted Dr. Hearn in performing tracheotomy for a foreign body in the right bronchus, the material was not discovered; the

edges of the wound were kept open by silver wire sutures, and the next day the material was ejected. E. Pevrissac¹ has successfully carried out a rather hazardous proceeding upon a man who had a plum-stone lodged in the left bronchus. He laid out everything ready for tracheotomy, in case it should become necessary to perform it. He then injected several centimetres of cold water into the trachea, the patient understanding that when the water had been introduced he was to stop breathing and gather himself for a violent cough. The cough which resulted was very forcible and expelled the stone.

The operation of opening the chest comes more within the domain of justifiable surgery, now that the x-rays may enable us to locate the foreign body. If the ordinary methods of treatment fail, if the case is desperate, and if the body can be located, such an operation must be considered. It is scarcely necessary to say that such an operation must be hazardous in the extreme.

True said, when all other methods fail, when the patient is in grave danger, when it is positive that a foreign body is lodged, and if we are certain where the foreign body is, we should operate. As he states it: "If you know accurately where it is, you must operate."² Just as we open through the lung substance to evacuate an abscess or a bronchiec-tatic cavity, so we can open through the lung to remove a foreign body which has set up inflammatory mischief. If the attempt is made, the two layers of pleura should be stitched together and the incision be made with a canter knife. A foreign body, if retained, leads to the formation of a putrid abscess; but, as Sonnenberg has shown, the abscess may be either around or some distance from the foreign body.³ Some surgeons have suggested that we should try to reach the bronchus from in front, without dividing lung tissue.

Other surgeons advocate reaching the bronchus from behind. These two last-mentioned methods do not seem feasible. Stephen Paget does not believe that we should attempt to incise the bronchus to reach a foreign body, and he agrees with Willard, of Philadelphia, who concluded, after a series of very valuable experiments, that it may be feasible to reach the bronchus, but it is not feasible to remove the foreign body and save the patient's life.

Abscess of the Lung. Operation for abscess of the lung is not a modern idea, as the operation was practised centuries ago, and enjoyed a species of popularity in the eighteenth century. It is only recently, however, that it has been placed upon a proper scientific basis, this having been greatly contributed to by the labors of Tuffier, Réclus, and True.

¹ *Revue hebdom. de Laryn., d'Otol. et Rhin.*, January 1, 1898.

² *The Surgery of the Chest*, by Stephen Paget.

³ Sonnenberg. *Wiener medicinische Blätter*, 1897, No. 40.

In rare instances a pulmonary abscess may undergo spontaneous cure, but such a termination is not to be expected. A great majority of such cases die from sepsis or are asphyxiated by a sudden flow of pus into the tubes. Abscess of the lung demands operation as imperatively as does abscess elsewhere, and this is particularly true of abscess at the base. The operation is known as pneumotomy, and is by no means as dangerous as are numerous other major operations. In 1895 Réclus reported twenty-three cases, with twenty cures and three deaths.¹ The two layers of pleura are usually adherent over an abscess, but not always. This question should be determined before the pleura is incised. Make an extensive flap, excise portions of several ribs, and inspect the pleura.² Tuffier³ says that when the parietal layer of the pleura is bared, pleural adhesion can be recognized by the fact that the pleura at this point appears gray and fibrous. If adhesions are absent the lung will be seen moving freely (Carl Beck). If adhesions exist, proceed at once with the operation; if they do not exist, take measures to produce them, and postpone further operation until they form. These precautions are taken because of the great danger of causing pyopneumothorax if the pus from the abscess is allowed to run into the pleural sac. Adhesions can best be produced by suturing the two layers of pleura together, but can also be produced by irritating with zinc chloride and afterward packing with iodoform gauze. Carl Beck does not suture the pleura if adhesions are absent. He thinks that stitch-holes may lead to infection. He simply opens the pleura, packs gauze around the spot where he intends to open the lung, and goes on with the operation.

The means recommended for locating the abscess is puncture, usually with a short aspirating needle, at various points. A long needle must not be used. This method, at the best, is a hap-hazard procedure. Sonnenberg greatly prefers Tuffier's method of exploration. In this method the parietal pleura is separated from the ribs, the surgeon inserts his hand between the ribs and the detached pleura, and locates the abscess at a point where there is noticeable hardening or marked softening.⁴ Some surgeons have objected to stripping off the pleura in this manner on the ground that pus might enter into this cavity and gather there. The x-rays may locate an abscess. If adhesions exist, after locating the seat of abscess, open into the abscess through the pleura and lung tissue. Sonnenberg's rule is useful: if the pulmonary tissues are hard, divide them with a knife, as there is no danger of hemorrhage; if the pulmonary tissues are soft, divide them with the cautery, because there is great

¹ Stephen Paget's *Surgery of the Chest*.

² Sonnenberg. *Wiener medicinische Blätter*, 1897, No. 40.
³ *Medicine*, December, 1897.

⁴ Sonnenberg. *Wiener medicinische Blätter*, 1897, No. 40.

danger of hemorrhage. Dangerous hemorrhage is rare, and the bleeding can usually be controlled by packing, and practically always with sutures or ligatures. Carl Beck says that recent cavities are more easily reached than are old cavities, as old cavities are more deeply situated. The latter can be best reached by an incision at the angle of the scapula.¹ The same author says, if puncture fails to locate the abscess, perform exploratory pneumotomy with a cautery. He has devised a platinum director which fits over the strip of the Paquelin cautery just as a canula fits over a trocar. The cautery is raised to a light-red heat and is carried into the suspected area and is withdrawn, leaving the canula in place.² The abscess should be opened freely. It should not be explored with the finger, nor irrigated. As soon as it is opened a gauze tampon should be inserted, because, if the abscess communicates with a bronchial tube, the patient will scarcely be able to breathe unless a tampon is applied.³ If we find that the abscess does not communicate with a bronchial tube, a drainage-tube can be employed.

Carl Beck inserts a narrow strip of gauze into the abscess cavity, cleanses the pleural cavity, and packs it with iodoform gauze. During the subsequent treatment he directs the patient to blow from time to time with his mouth and nostrils closed, to aid in evacuating the abscess cavity. During the first few days after treatment he gives the patient sufficient morphine to allay cough, and he gets the patient up in a few days.⁴

Bronchiectasis. Operations in these cases are unsatisfactory. The patients may improve for a time after the operation, but they generally grow worse, and most of them fail to improve at all. It is evident that operation must usually fail when we recall the fact that bronchiectatic cavities are generally multiple, that a cavity is apt to empty during anesthesia, and is then difficult to find and impossible to identify. Tuffier states that of forty-five cases of bronchiectasis which were operated upon, only seven improved.⁵

Sonnenberg says that only the single sacculated variety should be operated upon, and that the small multiple cavities almost invariably leave fistulae after operation.⁶

Tumors of the Lung. Tuffier tells us that primary tumors of the lung have not been operated upon, but in several cases secondary sarcomata have been successfully removed and the pneumotomy wounds have healed.⁷ It is not justifiable to remove secondary malignant growths

¹ Carl Beck. *Journal American Medical Association*, October 2, 1897.

² *Ibid.*

³ Sonnenberg. *Wiener medicinische Blätter*, 1897, No. 40.

⁴ *Journal American Medical Association*, October 2, 1898.

⁵ *Medicine*, December, 1897.

⁶ *Wiener medicinische Blätter*, 1897, No. 40.

⁷ *Medicine*, December, 1897.

from other regions ; it must be less justifiable to remove them from the lung. It subjects the patient to a dangerous operation which cannot cure him, and an occasional recovery from operation does not save from condemnation a procedure which must throw discredit on surgery.

Gangrene of the Lung. Operation is reasonably successful, forty-seven cases in which operation was performed, with thirty-five recoveries, being on record.¹ If unoperated upon, Réclus says that 70 per cent. of such cases die. If a gangrenous cavity is large and circumscribed, it should be incised and drained ; but it is useless to operate for diffuse gangrene, and needless to operate if the area of disease is not extensive and the patient's condition is good (Réclus).

Tuberculosis. The advisability of operating upon pulmonary tuberculosis has been widely discussed. Such operations were, for a time, extensively practised and, in spite of certain notable successes, very generally condemned. They have recently been revived by some surgeons, especially in France and Germany.

Various unsuccessful attempts have been made to treat pulmonary cavities by introduction of a canula and injection of an antiseptic solution, by institution of permanent drainage, and by injection of corrosive sublimate into the lung parenchyma. As George Ryerson Fowler has said of pneumotomy, this operation "can only be indicated in cases in which circumscribed pulmonary affections exist and the patient's strength will admit of interference."

This operation is positively unjustifiable if the area of disease is not circumscribed, if several foci of disease exist, or if the disease is rapidly progressive or stationary. To operate on a single focus of disease when other foci exist would do no good ; to operate on a rapidly progressive area would do positive harm ; to operate on a stationary area would be to invoke doubtful surgery in a case in which recovery might occur without it. It is often difficult, or even impossible, to say that a tubercular focus in the lung is stationary or advancing slowly, and it is very difficult to locate a cavity with accuracy, although the x-rays may aid us to do the latter. J. Edward Stubbert² tells us what we can discover by the Röntgen rays. He says : Beginning tuberculosis is shown by haziness ; well-marked shadows mean consolidation ; a cavity is marked by a circumscribed area of "bright reflex" surrounded by a ring of shadow or by a large area of pronounced shadow ; thickened pleura over consolidated lung is indicated by great darkness. Williams, of Boston, agrees with the conclusions of Stubbert, and both observers state that reliable results can only be obtained by much practice.

¹ Sonnenberg. Wiener medicinische Blätter, 1897, No. 40.

² Yale Medical Journal, February, 1898.

Fowler says, in his admirable study published several years ago,¹ that only a small area is really accessible for operation, and the field in which we can operate is bounded above by the clavicle, internally by the sternum, externally by the lesser pectoral muscle, and below by the second rib. Tuffier says that tubercular cavities heal very slowly and operations on such cases give very bad results.² The weight of opinion is against the performance of pneumotomy for a tubercular cavity. There are very few cases in which it can even be thought of. It usually fails to benefit the patient; it is dangerous to life, and it cannot cure the disease, for, as Réclus has said, "the tubercular disease itself is still left behind." Some surgeons advocate resection of areas infiltrated with tubercle (pneumectomy), the operation being advocated on the same grounds as resection of a tubercular joint; but the conditions are not the same, because the anatomical structure is not identical. As Fowler has well said, the pulmonary structure is more susceptible to infection with tubercle bacilli than is any other tissue in the body, and, because of the anatomical structure of the lung, infection tends strongly to spread and reinfection is apt to happen if disturbances of nutrition occur. Successful pneumectomies for tubercle have been recorded. Tuffier, in his report to the Twelfth International Medical Congress, stated that in one case he had succeeded in removing a tubercular area, doing it just as he would remove a tumor, and the patient recovered. Two other similar cases have been recorded. I believe that a stationary area of disease runs a far better chance of being cured without surgery than with it, and that an advancing area of disease cannot possibly be cured by operation. In either case operation might be fatal. In the words of Réclus, "resection of a tubercular focus ought to be proscribed."

John B. Murphy, of Chicago, advocated another method of surgical treatment in a paper read before the Denver meeting of the American Medical Association.³ He is doubtful of the value of pneumectomy in tuberculosis, and in such an operation it is impossible to tell how much lung should be removed. Reflecting on the fact that nature's method of curing tubercle is to deposit connective tissue around the tubercular area, the proper plan of treatment is to endeavor to cause fibrous tissue to form. In other parts of the body we often secure this result by rest, and we should try to apply a similar plan to the lung. There are three methods by which the lung can be put at rest:

1. By resecting ribs and allowing the chest to contract around the diseased part.

¹ Surgery of Intrathoracic Tuberculosis. *Annals of Surgery*, November, 1896.

² *Medicine*, December, 1897.

³ *Journal of the American Medical Association*, July 23, 30, August 6, 1898.

2. By opening the chest-wall and allowing it to sink in over an area of pulmonary tuberculosis.

3. By injecting a non-poisonous gas into the pleural sac, thus producing collapse of the lung.

Murphy injects nitrogen gas and reports five cases which he claims to have cured. Nitrogen gas is non-poisonous and remains for months without being absorbed. It is introduced through a needle on which is a stopcock, the injection causing no pain and greatly relieving cough, though it may produce slight dyspnea.

After an injection the patient feels well. In a few weeks after operation the gas is withdrawn, but if it is found that cough returns the nitrogen is again introduced. Murphy says there are slight risks in the method, the chief danger being the entrance of gas into a vein, but there is no danger of displacement of the diaphragm or collapse. He thinks also that incipient cases can be cured by this method, and even in advanced cases the disease can be brought to a stand-still. Food and climate should be utilized as adjuncts. He reports five successful cases which occupied from four to eight weeks, and showed with them skiagraphs taken before and after treatment.

The production of a temporary pneumothorax for the cure of pulmonary tuberculosis was suggested by an Italian surgeon some years ago.

Murphy's results are most striking and remarkable. Such a procedure, certainly at a first glance, would not seem promising nor advantageous in pulmonary tuberculosis. In fact, the condition of pneumothorax is considered a grave complication of phthisis. It is only fair to admit, however, that the similarity is not exact between a pneumothorax induced by lung disease and that produced by design, as the former will probably produce pyothorax and the latter will not. It has been stated in some text-books that compression of the lung, either by effusion or by air, checks the progress of pulmonary tubercle. Stephen Paget says, "in some cases of tubercular phthisis, with slight effusion, the presence of a moderate amount of air or fluid tends to check the advance of the disease."¹ Samuel West² does not think that such a view is based on conclusive evidence, and maintains that what evidence there is points the other way. He points out that recent tubercle may be found in a collapsed lung, all evidence going to show that it developed after collapse, and that collapse of one lung is frequently followed by the development of tubercle in the other lung. West says that this theory once stood in the way of aspirating for serous effusions and draining empyemata, but in dealing with these two conditions we have almost forgotten that such a theory was ever held. It is well, also, to remember that post-mortem

¹ *Surgery of the Chest.*

² *British Medical Journal*, November 27, 1897.

studies show that in 10 per cent. of cases dying of phthisis, pneumothorax exists (Habersham).

The questions to determine about Murphy's method are: Is it safe? Will it cure? Will it palliate? Will it be followed by tuberculosis in the other lung?

These questions can only be answered by careful trial, and we favor such trial. In such a relentless disease as phthisis, which kills vast numbers of the human race, any method which promises well and is not too dangerous should be tried with scrupulous care.

Empyema. It is an undoubted fact that empyema occasionally undergoes spontaneous cure. Such an event is rare, but may occur, and clear examples of it are recorded in literature. In Rosenstock's case pus was found by exploratory puncture; but one year later the patient was found to be entirely well. Spontaneous absorption is most apt to occur in children and in empyema due to pneumococci, but it may occur in other forms of infection, especially the empyema of influenza. A small empyema may be cured by becoming encapsulated, a large empyema by breaking into a bronchus or rupturing externally. Rupture into a bronchus is usually followed by pneumothorax, but in a pneumococcus empyema it may occur without this complication, rupture being then effected by the necrotic method described by Traube.¹ It is very dangerous, however, to trust to nature in these cases, for if not treated surgically almost all of them will die. Rupture into a bronchus is apt to cause death, and death may also be caused by septicemia, pericarditis, or peritonitis. Whenever pus is present it should be removed, and the sooner it is removed the better the prognosis.

Charles E. Lockwood² has well said that delay in operating permits of thickening of the pleura and the formation of dense adhesions, conditions which prevent lung expansion and hinder repair when operation is finally performed. It is essential to know that there is pus in the pleura and in coming to a conclusion to remember that it is possible to have empyema without fever. In order to be certain of the existence of pus in a doubtful case, it may be necessary to make a diagnostic puncture or aspiration. Puncture can best be effected by a large hypodermatic syringe with a long, strong needle, and it should be performed with aseptic care, for infection may convert a pleural effusion into an empyema and an empyema into a putrid empyema. The surgeon must try to avoid going deep enough to injure the lung, although even if the lung should be struck it is unlikely that harm will result. After introducing the needle see that the point moves freely. If the first puncture fails to find fluid, one or several more can be made. If fluid is found and removed it

¹ Robt. J. M. Buchanan. *Liverpool Medico-Chirurgical Journal*, July, 1898.

² *Medical News*, December 25, 1897.

should be studied microscopically and bacteriologically. Fowler cautions us to avoid considering one dry tap as final, because, the needle may be lodged in a soft mass or in a callosity.

When it is certain that pus is present, the bacteriological report may determine what further is to be done. If the condition is found to be tubercular, and the patient is young and is suffering under active phthisis, radical operation will probably be fatal and will be especially dangerous if pneumothorax exists. It has been claimed that the pressure of the effusion benefits the phthisis, and the removal of such pressure makes the lung condition worse. If the patient is an adult and the phthisis is not progressing actively, operation is indicated. An operation should be performed upon empyema due to any other infection. In tubercular empyema the bacilli of tubercle often disappear from the effusion after having been present in it; hence, while the presence of bacilli proves the existence of tuberculosis, their absence does not prove the converse.

We have a number of operations to select from. Aspiration may cure an acute empyema, especially pneumococcic empyema in a child; but, as a rule, cure is not obtained. It cures 20 per cent. of cases in children (Holt). It occasionally, but very rarely, cures in tuberculous and other infections. It is a useless measure in chronic empyema. It can be used if empyema exists on both sides or if the effusion is seropurulent. It can be used for diagnosis, and it can be used as a temporary expedient to relieve the breathing when there is great dyspnoea from a large effusion. It is a good plan, when there is a very extensive effusion, to aspirate and remove about half of it, and then, in a few days, perform a more radical operation. If this is done the breathing will be considerably relieved, and when the operation is performed the patient will take an anæsthetic better and will not be nearly so liable to sudden death. Some surgeons have advised aspiration with antiseptic irrigation; but an antiseptic under these conditions is but a puny antagonist. Some tap with a trocar and canula. Some have tapped with the trocar and canula and have retained the canula in order to secure permanent drainage. Pichler¹ advocates the latter plan, but only in acute cases. He reports 13 cases; 5 of them were cured, 6 died, and 2, each of which was tubercular, were not benefited. Such a heavy mortality contrasts unfavorably with methods which are far more radical, and we would select one of the latter rather than it. Further, it must leave masses of fibrin in the pleural sac.

Pichler operates as follows: He uses a trocar having a diameter of 6 mm.; he incises the skin, inserts the trocar and canula, withdraws the trocar, and leaves the canula in place. Pichler admits that some pus is

¹ Deutsche Archiv f. klin. Med., December 22, 1897.

apt to find its way to the surface outside of the tube. This is an unpleasant complication and may lead to caries of the rib (it did so in the two tubercular cases). Pichler tries to correct this accident by inserting a large tube, but he often fails. He says that the appearance of fetid pus is a grave complication, and if this appears we may wash out with antiseptic fluid, but had better do thoracotomy. The author of this method uses it chiefly in acute cases, although he considers it justifiable to try it in chronic cases, but he will not use it unless the patient remains under his immediate control, and will not employ it if there is marked respiratory disturbance. Permanent drainage is impossible in a child. Bulau inserts a large canula between the fifth and sixth ribs, through this canula carries a rubber drainage-tube into the pleural cavity, puts the patient to bed, and attaches to the tube a siphon drain; but even such an arrangement is apt to become blocked. It may cure, but often fails.

Simple incision with drainage is a useful operation. It will cure many recent cases, and is safer than resection. Usually in a child we can drain through an intercostal space (Cantley). It is especially valuable when the lung is not bound down by adhesions. Place the patient on the back or on the diseased side, but never on the healthy side. To turn him on the healthy side while taking an anæsthetic may kill him. Give chloroform in preference to ether. If the patient is in a very bad condition employ only a local anæsthetic. If the effusion is very large it is well to remove part of it before operating. In every case just before operating prove the presence of pus by using an aspirator (Stephen Paget). The incision need not be made at what will be the most dependent part of the pleural cavity, because, as Sunderland has emphasized, after incision an empyema is not drained by gravity, but the pus is forced out by lung expansion and ascent of the diaphragm. In a circumscribed empyema the incision should be made into the area of effusion. In a diffuse empyema the incision should be made over the seventh or eighth interspace external to the angle of the scapula. After division of the intercostal structures a short tube is introduced, as a tube long enough to touch the lung causes much irritation. B. Farquhar Curtis¹ cautions us to fix the tube so that it cannot slip into the chest. He says the tube must be of fresh rubber, and it must be changed whenever it becomes brittle. If the tube is composed of good rubber he says it should be anchored by passing a safety-pin through the outer end and tying to the extremities of the pin pieces of adhesive plaster or threads which are tied around the body.

The drainage-tube should not be kept in long, or it will cause a fistula to form. It ought to be removed when the discharge is greatly

¹ Medical Record, March 19, 1898.

lessened in amount and when it becomes sero-purulent. It is usually removed by the fifth day after operation for an acute case, but may be retained much longer. Curtis¹ says some authorities leave the tube in place until cicatrization pushes it out, and he considers that in some respects the advice is sound, because, of two evils, a sinus is less to be dreaded than is reaccumulation of pus. He tells us, if the cavity of an empyema is contracted to a narrow cavity between the lung and chest, the tube should almost reach the end of the cavity. Curtis considers it a good rule to have a drainage-tube one-half an inch shorter than the sinus, so that it will not press upon the deeper parts of the canal. If the tube does not drain out all of the fluid we can clear the pleura by having the patient, several times a day, attempt to expire forcibly while the mouth and nostrils are closed. After the wound in the chest heals every attempt is made to cause the chest and lung to expand. Every day exercise is employed, and artificial respiration is carried out for a time by Sylvester's method (Sunderland).

Suppose, after incision, it is found that the intercostal spaces are too near together to permit of drainage. We can then trephine a rib, or bite away a portion of the upper border of the lower rib with surgeon's forceps, or, what is far better, resect a portion of a rib by a subperiosteal operation and insert a drainage-tube. Some surgeons never employ simple incision, but always resect one or more ribs.

Should we irrigate in such cases? As a rule, no. Irrigation is dangerous. It may produce pleuritic epilepsy or cardiac failure. The use of peroxide of hydrogen is forbidden, for it may lead to the formation of emboli. It is impossible to kill the germs in the pleura by introducing antiseptics. The introduction of fluids tends to force the lung away from the chest-wall, and thus prevents obliteration of the cavity. Nevertheless, if pus is putrid, the retained irritant toxins will do more harm than will the injection of fluid, and we should inject normal salt solution or a solution of boric acid, and, if large clots are present or masses of fibrinous exudate are in the pleura, they can be removed with a scoop (Fulton). If a fistula forms irrigation is necessary. If irrigation is employed the best way to use it is by submersion, a method suggested by Zeman about one year ago. This method is particularly useful when a fistula forms. The patient gets in a bath and respires, fluid being sucked in and forced out strongly, and masses of fibrin and blood-clot are brought out. Zeman advises that the bath consist of boiled water and that it be continued for ten or fifteen minutes daily, the fluid coming out clear after this time.

S. A. Adams described this method to the American Pediatric Society.

¹ Medical Record, March 19, 1898.

He says that during the immersion the cavity is washed out two hundred or three hundred times, instead of three or four times as in the ordinary method; the bath removes thick and adherent matter, lessens the formation of pus, and economizes dressings. In a case reported by Adams the baths were given at first every day, and later every other day for two months, by which time the child was well. The bath may consist of boiled water, saturated solution of boric acid, or normal salt solution. Adams prepares the bath just as the Brand bath is prepared, and keeps it warm by adding hot water from time to time.

An operation occasionally practised is that of intercostal opening and counter opening, and pulling a drainage-tube through and through. I do not believe in this method. Drainage, as we have said before, is not effected by gravity, and the long tube is a source of irritation.

In an empyema which has ruptured externally, or in an empyema which thoracotomy has failed to cure, a more radical operation is necessary. A sinus may be due to rib necrosis, and if this condition exists the diseased bone is resected. In a persistent empyema the lung, tied up by adhesions, cannot expand, and we must do an operation which permits the falling in of the chest-wall and the consequent obliteration of the cavity. When the mountain would not go to Mahomet he had to go to the mountain, and when the lung will not go to the chest-wall the chest-wall must be taken to the lung. If thoracotomy has failed to cure an empyema in from four to six weeks, do the operation of thoracoplasty (Curtis). Estlander removes a portion of every rib which overlies the cavity. This will cure many cases; but if the pleura is very thick it will prevent the chest-wall from falling in, and the operation will fail to cure. Schede makes a large horseshoe flap from the level of the axilla and the second rib in front to between the scapula and the spinal column behind. The convexity of the flap is downward, and it reaches the lower limit of the pleura. The flap is raised and the scapula is lifted. The ribs, from the second rib downward, are removed from their costal cartilages to their tubercles along with the intercostal muscles and the parietal layers of the pleura, and the raw flap is laid against the visceral layer of the pleura. In some cases a fistula follows even in this operation, because it is very difficult to carry the flap well up into the apex of the pleural space.

Sudeck¹ objects to Schede's operation because it is very difficult by this method to obliterate the apex of the cavity. He has devised an operation which he thinks accomplishes the obliteration of the cavity and one which can be done more quickly than Schede's. An incision is begun at the cartilage of the fourth rib and is carried horizontally outward and

¹ Deutsche Zeitschrift für Chir., Bd. xlvii., Heft. 2 and 3, 1898.

backward across the scapula to a vertebral arch. A second incision is made, which incision is on a level with the floor of the pus cavity and is parallel to the first incision. These two incisions are joined by a vertical cut in the axillary line. The three incisions make the figure **I**. The flaps are lifted front and back and the ribs are resected from the third to the tenth inclusive. The thoracic wall and the thickened pleura are removed from the level of the floor of the cavity up to the second rib, and the flaps are packed into the cavity. A certain amount of raw surface is left which should subsequently be grafted.

Pneumothorax. The majority of cases are due to phthisis. It is known that some cases are converted into pleuritic effusions and recover, but more cases are converted into pyothorax and die if operation is not performed. Yet operation for pneumothorax has found many opponents.

It is generally acknowledged that in a young subject laboring under rapidly advancing phthisis, operation will be futile and probably fatal; but it is also true that in an older subject with a more slowly progressing condition, operation may be of great benefit. It has been asserted that a moderate amount of air or fluid benefits the pulmonary phthisis, but this assertion is not proved. In pyopneumothorax we must operate just as we do in pyothorax. Fowler has pointed out that in operations for pyopneumothorax great care must be taken to avoid injury to the diaphragm, for during respiration that organ moves freely. He further says, and with great truth, that if irrigations are employed they must be given with extreme care, otherwise the fluid may run into the respiratory tract and suffocate the patient. If the lung is bound down by adhesions, incision is dangerous but is justifiable. Aspiration is useless if the bronchus is open, because air enters into the pleura as rapidly as it is removed through the aspirator. Incision is dangerous because, when the pleura is opened from without, there is great alteration produced in the air pressure within the chest and the patient may "drown in his own secretions."¹

Samuel West² ably states the case of those who believe that operation should be performed for pneumothorax. He says such cases are often regarded as incurable because of a belief in certain erroneous theories. One theory is that a lung which has been compressed for some time by air or fluid must be bound down by adhesions and be incapable of expanding. There is no doubt, says West, that in pneumothorax the lung does become bound down by adhesions, but these are the cases which were let alone, and if operation had been performed at the proper time they would not have been bound down by adhesions. He goes on to

¹ B. Farquhar Curtis. *Medical Record*, March 19, 1898.

² *British Medical Journal*, November 27, 1897.

state that in exceptional cases the lung cannot expand after incision, but, as a rule, it will expand. Another theory is that the contraction of the lung checks tubercle. West says there is no proof that this theory is true, and he considers it to be erroneous, for he has seen recent tubercle in a collapsed lung, the collapse having antedated the tubercle, and he is sure that the collapse of one lung may be followed by the development of tubercle in the other lung. The third theory is that incision is not satisfactory. West says if incision is employed it must be done at the proper time. He thinks that incision is very dangerous in the early stage. In this stage he would use paracentesis without suction, to relieve the urgent symptoms, repeating it if necessary. If paracentesis fails to relieve the symptoms, we may operate; but if it does relieve the urgent symptoms, wait awhile. If the symptoms permit us to delay, do so. In simple pneumothorax the air may be absorbed and the patient cured. Some cases of hydropneumothorax are cured by repeated paracentesis without suction. If pyopneumothorax arises, West says we should perform thoracotomy.

Suture of the Heart. It has long been a popular impression that a wound of the heart is inevitably and almost instantly fatal, and the words "shot in the heart" or "stabbed in the heart" have come to be synonymous to the public with immediate death. Such a view is not strictly true. Del Vecchio and Philippoo made a series of experiments on animals. They found that wounds of the heart and pericardium are not always immediately fatal, and it is possible to suture them successfully. Post-mortem examinations have, in a few instances, disclosed the scars of healed wounds of the heart, the cardiac injury having had no influence in producing death. Block, in 1882, showed that it was possible to suture a wound in a rabbit's heart. The heart has been punctured a number of times either by accident or intention, and the patients have not died from the injury. In 1881 John B. Roberts, of Philadelphia, suggested that in heart wounds it might be possible to incise the pericardium, remove blood-clots, and suture the wound in the heart, and since that time this suggestion has been practised successfully. A most brilliant case was that under the care of Parrozzani, of Rome, which case was reported by G. Sandison Brock in the *Lancet*.¹ The patient had been stabbed in the left ventricle. The pleural sac was opened and emptied of blood, and a wound was found at the apex of the pericardium, which accounted for the fact that there was no clot within the pericardium. A wound was also found entering into the left ventricle. This wound was sutured with silk and the patient recovered.

The same surgeon operated on a second case, but death ensued on the

¹ July 31, 1897.

second day, a necropsy showing that the interventricular septum had been perforated. Prof. Tassi, of Rome, has stated, according to Brock, that during the past six years eight cases of wounds of the pericardium, or of pericardium and heart, have been operated upon in Italy. Out of four cases in which the pericardium only was injured, three recovered; out of four cases in which the heart was also wounded, one recovered (Parrozani's case). Durante reported a case of heart wound sutured by Farení. The patient lived several days and died from causes not connected with the heart injury.¹ Cappelen reported a case in which a patient lived two and a half days after suture of the heart,² and Rehn reported a successful case of heart suture to the Congress of German Surgeons in 1897. Frank Blaisdell³ reported the case of a boy who ran a needle into his heart. The needle was extracted and the boy recovered. Samuel Prior⁴ reported the case of a lunatic who drove into the wall of the heart an iron spike three-sixteenths of an inch in diameter. The cavity of the ventricle was not opened. The spike was withdrawn, the wound was dressed antiseptically, and the patient recovered.

Semeleder⁵ reports the case of a man who was stabbed in the back and also between the third and fourth costal cartilages of the left side about one inch from the edge of the sternum. The posterior wound gave no trouble and the anterior wound was doing well. The patient was seized with abdominal pain six days after the accident, and died one day later. Necropsy showed a healed wound of the pericardium and a healed wound half an inch long in the right ventricle, though it did not enter the cavity of the ventricle. The patient had died of a sero-sanguineous pleural effusion compressing the lung.

Semeleder's case proves that a heart wound, at least one which does not enter a cavity, may heal when uninterfered with, and that in such cases death due to compression of the heart from a pericardial blood-clot is not inevitable. Parrozani's case, before quoted, shows that even if a cavity is open, blood-clot will not gather in the pericardium if the pericardial wound is at the apex of the sac.

J. Rudis-Jacinsky⁶ reports the case of a man who was stabbed in the temporal region and also in the pericardial region. The last-named wound was below the fifth rib and one and one-half inches to the left of the middle of the sternum. He introduced a probe and found the wound to be three inches deep, passing through the pleura, lung, pericardium, and into the heart. The wounds were cleansed and dressed,

¹ *Revue de Chirurgie*, 1897, p. 335.

² *Norsk Magazine for Lægevidenskaben*, March, 1896.

³ *Atlantic Medical Weekly*, August 7, 1897.

⁴ *Lancet*, October 9, 1897.

⁵ *Wiener med. Presse*, 1898, No. 48.

⁶ *New York Medical Journal*, April 23, 1898.

and the patient was kept at rest as absolute as possible. On the fifth day the pleural sac was opened and an extensive hæmothorax was drained. After some vicissitudes this case recovered. The author states that Fischer collected the records of 401 cases of wounds of the heart. He found that 50 of these recovered, and the diagnosis in 33 of the 50 cases was subsequently confirmed by autopsy long after. The proof that the heart was wounded does not seem absolute from Rudis-Jacinsky's description. It may have been, but the evidence given by a probe is often unreliable, and the use of a probe is very generally an injurious procedure.

Reported cases point to the following views as correct.

Wounds of the pericardium or of the pericardium and heart should be sutured.

In order to reach the heart several ribs may be resected, and very generally the pleura must be opened. A feasible plan of reaching the organ is that employed by Parrozzani. In his case the wound was in the seventh interspace at the crossing point of the midaxillary line. He made an incision in the fourth interspace, beginning it at the left margin of the sternum and ending it at the midaxillary line. From the termination of this incision he made a second incision, vertical in direction, passing through the wound and ending below the ninth rib. The first incision divided superficial structures and the pleura. The second incision divided superficial structures, the pleura, intercostal structures, and the fifth, sixth, seventh, eighth, and ninth ribs were cut through in the line of the vertical incision. This trap-door was opened, the hinges of it being the rib cartilages.

After exposing the heart, clots must be removed from the pericardial sac by irrigating with hot saline fluid.

The wound in the heart should be sutured by means of a round curved needle threaded with fine silk.

If a cardiac cavity is open, the suture should include the entire thickness of the heart-wall except the endocardium.

The pericardium should also be sutured with silk, and drainage can be employed if it is desired. Drainage is not imperatively needed, and it was not used in Parrozzani's successful case. In one successful case the pericardial sac was packed with iodoform gauze. Clots should be removed from the pleural cavity by irrigation and bleeding from the lung should be arrested by ligatures.

If the patient's condition admits of it, a wound in the lung should be sutured, especially if there is an opening into the air-passages. During the performance of the operation of suturing the heart, autotransfusion should be employed; hot saline fluid should be thrown into a vein, the patient should be wrapped in hot blankets, his head should be kept low; an enema of hot coffee and whiskey should be given, and strychnine

should be given hypodermatically. It is rarely justifiable to give an anæsthetic.

Aneurisms of the Aorta and Innominate Artery. In aneurisms of the aorta or innominate artery it is well to try medical treatment. This consists in rest in bed, a restricted diet, the administration of iodide of potassium or chloride of calcium, and, possibly, the occasional employment of venesection. Injections of gelatin dissolved in salt solution and thrown into the subcutaneous tissues of the buttock have been suggested. In an aneurism of the innominate, pressure may be employed if medical treatment fails. If medical treatment fails in an aortic aneurism, and if medical treatment and pressure fail in an innominate aneurism, surgical treatment is to be considered. Our choice practically lies between distal ligation, galvano-puncture, and introducing wire into the sac.

In considering the advisability of distal ligation we should read the views of Barwell in Ashhurst's *International Encyclopedia of Surgery*, of Holmes in his *System of Surgery*, and should particularly bear in mind the admonitions set forth by Jacobson in his *Operative Surgery*. This last-named authority states that possibly too much importance has been attached to a few successful cases and too little thought is given to the fact that numerous unsuccessful cases have not been published. Jacobson reminds us that operative treatment in some cases only hastens death, not only because of the difficulty of operation but because other aneurisms may exist and distal ligation may cause them rapidly to distend. Henry Morris thinks that distal ligation of the right side should be limited to desperate cases.

It was pointed out by Cockle thirty years ago, that in several reported cases of aortic aneurism in which accidental impaction had occurred, or in which, through mistake, the left common carotid had been tied, the aneurism had been benefited or cured. He suggested deliberately tying the carotid, and the operation was soon after performed by Heath, Holmes, and Barwell. Barwell showed that aneurism of the arch could be benefited by ligating the right common carotid. In an aneurism of the transverse portion of the aortic arch which is enlarging upward, Mr. Holmes thinks the common carotid of the left side should be tied; whereas, if the sac is passing outward under the sternocleidomastoid, the left subclavian should be tied. Some surgeons advocate consecutive and others simultaneous ligation of these vessels. In aneurism of the innominate or in aortic-innominate aneurism, Holmes advises us to tie first the right carotid, and if that fails to tie the right subclavian. Other surgeons have advocated simultaneous ligation of the vessels of the right side in aneurisms of the ascending arch of the aorta which arise below the origin of the innominate or which involve the innominate, and also

in pure innominate aneurism. The only form of aneurism in which distal ligation is proper is the single sacculated variety. If there are other aneurisms the results of operation may be disastrous. It has been shown that aortic dilatation will not be improved by the procedure. It is worth trying in selected cases of sacculated aneurism, for it seems to have cured some cases and to have greatly benefited others. Now that the X-rays enable us in some cases to localize and determine the contour of an aneurism of the aorta more accurately than was formerly possible, we may be able to form positive conclusions as to the proper vessels to ligate. Barwell has laid down a series of rules to guide us in the selection, and the future will show how absolute they are to be considered.

R. C. Hill¹ has reported a case in which he treated an aneurism of the aorta by simultaneous ligation of the right common carotid and the right subclavian. The aneurism arose from the arch below the origin of the innominate. Hill tied the vessels with kangaroo tendon, and the wounds healed by first intention. After the operation the pulse was very weak and rapid, and the patient expectorated much bronchial mucus. This secretion of mucus was due partly to the anæsthetic, partly to venous congestion dependent on arterial obstruction, and partly to diminished sensibility of the larynx, which permitted an occasional entry of fluids which were being swallowed. There was lessened sensation in the right side of the face and also in the right arm.

Five days after operation bruit was much fainter, and two weeks after operation there was no visible pulsation. The patient is apparently cured, has very little pain and dysphagia, and there is a depression on the chest-wall at the site of the former prominence.

This striking case of Hill's emphasizes the great value of distal ligation in suitable cases.

Mammary Gland. The views of surgeons have undergone great alteration during the past fifteen years in regard to the possibility of curing carcinoma of the breast. In times past the gloomiest views were entertained regarding the prognosis. Billroth's cases, tabulated by Von Winiwarter in 1878, showed eight cures in 143 cases. Trendelenburg estimated that 4 per cent. of cases were cured, while Benedikt in his late years entirely gave up operating on these cases. Velpeau in his entire career had only seen twenty cases in which it could be claimed that a cure had been obtained,² while Sir James Paget stated that he never saw a single case cured. Such views arose from the fact that the operation which was employed was entirely inadequate. In most cases elliptical flaps were made, the tumor only, or the breast alone, removed, and the flaps were then neatly

¹ Cincinnati Lancet Clinic, March 19, 1898.

² Operations for Cancer, by W. Watson Cheyne.

approximated. Some few surgeons removed the axillary glands if they were obviously diseased; but many would not remove them even then, and no one removed them if they were not so much enlarged as to be palpable externally. In spite of the comparatively trivial nature of this proceeding, the mortality was large before the days of antisepsis (Billroth's cases showed a mortality of 23.7 per cent.). The incomplete or partial operation, when the patient recovered from it, prolonged life, Cheyne estimates, only six or eight months.

At the present time a much more radical operation is performed. The views promulgated by Moore, of London, in 1867, founded a new school of opinion. He believed that cancer had a local origin, and he advocated extirpation in one mass of the entire mammary gland, the skin over it, and adjacent structures which were infected. The younger Gross, in 1880, in his work on *Tumors of the Mammary Gland*, insisted that the only proper course was to make a circular incision around the breast, remove the breast, outlying lobules and the pectoral fascia, open the axilla and remove the axillary glands and fat. From the studies, particularly of Moore, Mitchell, Banks, the younger Gross, Heidenhain, Lister, and Volkmann, has come the modern or complete operation. This is an extensive procedure. The surgeon believes that cancer in the beginning is a local disease; that thorough removal will produce genuine cure; that recurrence means incomplete removal, and that the earlier operation is performed the better is the chance of complete removal, hence the better is the chance of cure. In a complete operation there should be removed the skin over the mammary gland; the gland itself; the subcutaneous tissue "from the sternum to the axilla, and from the subclavian fossa to the cartilage of the seventh rib" (Snow); the sternal portion of the great pectoral muscle, and the contents of the axilla, except the vessels and nerves. In some cases the entire great pectoral muscle is removed and also the lesser pectoral.

Some surgeons also remove the supraclavicular glands (Halsted, Arbutnot Lane), although the value of such a procedure is doubtful, because when these glands are infected, the mediastinal glands and the thymus are certain to be. The type of the modern operation is the method employed by Halsted. The modern complete operation shows vastly improved results. In estimating cures it is usual to take the three-year limit of Volkmann. This limit is not absolute, because cases do recur later; but practically it is true, at least so far as regional and local recurrence is concerned, although it is probable that many deaths which occur from some internal malady in four, five, or six years after operation are really due to visceral carcinoma. Over 45 per cent. of cases operated upon die within three years. Even in such cases, however, the operation greatly prolongs life. Bull's statistics show 26.6 per cent. of cures.

Warren's show seventeen cases, out of seventy-two operations, which have passed the three-year limit. Many of these operations were performed before the present extensive operation came into vogue, and many were desperate cases. Warren says it is humane to sacrifice statistics in order, once in a while, to save a desperate case.¹ Halsted reports seventy-six cases operated on more than three years ago, of which forty, or 52 per cent., lived more than three years without signs of local or regional recurrence.² Rotter reported 50 per cent. cured. Dennis shows 45 per cent. cured. May shows 35 per cent.

The mortality from this operation is remarkably small. May reported seventy-six operations without a death. Dennis had one death in seventy-four cases, and that was due to hæmophilia. Cheyne had one death in sixty-four cases, and that was due to ether.³ Halsted has had 133 cases without a death.⁴

Certain objections have been made to the extensive operation.

It has been asserted that cancer of the breast is incurable, and that extensive operation is simply unjustifiable mutilation. This is answered by the statistics of cures obtained. It has been claimed that such an extensive operation must be dangerous, but we answer this by the proof that the mortality in large numbers of cases is only about 2 per cent. Dowd says, with truth, if hemorrhage is arrested and asepsis is maintained the radical operation is no more dangerous than is the Volkmann operation.⁵ Another objection which has been made is that the removal of muscles will permanently impair the usefulness of the arm; this is not true, for patients can use the arm with considerable freedom; can do household work, and can raise the hand to the head. It is extraordinary how slight the permanent disability usually is.

Some have claimed that free removal of the muscle is not necessary in recent cases, and is only to be employed when the muscle contains nodules of cancer; but Halsted has shown that the muscle, like the axillary glands, may look and feel normal and yet be infected with carcinoma; and it seems wise always to remove the muscle just as it is wise always to remove the glands. As Dowd says, if any cases are to be denied radical operation it should be the advanced cases and not the recent ones, for in many of the advanced cases the growth has passed beyond limits accessible to operation, but in recent cases there is hope of eradicating the disease.⁶

The radical operation takes much time to perform. The patient must

¹ Warren. Boston Medical and Surgical Journal, August 25, 1898.

² Transactions of American Surgical Association, 1898.

³ See the statistics in Charles N. Dowd's paper, Annals of Surgery, March, 1898.

⁴ Transactions of American Surgical Association, 1898.

⁵ Dowd. Annals of Surgery, 1898.

⁶ Ibid.

be carefully prepared, and precautions must be taken to prevent her becoming chilled. The dry aseptic method is the best plan to employ. Just before beginning the operation make an exploratory incision in order to verify the diagnosis. On more than one occasion the breast has been removed for an abscess or a hard fibroma. After deciding that the tumor is carcinomatous, roughly suture the wound, asepticize the surface, and put aside the knife. The surgeon asepticizes his hands and proceeds with the operation, employing a sterile knife. These precautions are taken to prevent the planting of carcinoma cells into the tissues as they are cut, for if such cells are implanted they may grow, just as a skin graft grows. Failure to take such precautions may be responsible for a return of the disease.

Whereas I believe in exploratory incision at the time of operation, I do not believe in exploratory puncture before operation. Maurice Richardson calls attention to the dangers of preliminary exploratory puncture. He says¹ that an existing nodule may be overlooked, and that cancerous infiltration may spread widely after puncture.

During the operation every bleeding point should be caught up and ligated. If the incisions have been so planned as to permit closure of the flaps, they should be sutured with silkworm-gut after an opening has been made for a large drainage-tube "at the most dependent part of the wound, through the lower flap about opposite the midaxillary line."² In the Halsted operation the wound cannot be closed completely, and it is at once covered with Thiersch grafts. It is very important in dressing the case to apply firm pressure, so as to obliterate any dead space. The dressing can be held in place by a firm gauze bandage around the body, and the arm is placed in a sling and bound to the side. Dowd applies over the dressing a sort of vest with one short sleeve, and puts the arm in a sling. Edward Cottrell³ maintains, truly, that binding the arm to the side causes discomfort and even pain. He thinks, if this is done, after the wound has healed the movements of the shoulder will be limited and painful. He advocates keeping the arm at a right angle to the body by the use of a rectangular splint. This instrument is fitted with a movable joint, and when it is used the hand and forearm are left free; there is neither cramp nor stiffness of the muscles, and when the splint is removed there is no stiffness of the shoulder. Patients can usually get up on the eighth or ninth day after this operation.

CASES NOT SUITABLE FOR RADICAL OPERATION. The conditions set forth by A. Marmaduke Shield⁴ are those which govern surgeons in general.

¹ Boston Medical and Surgical Journal, October 27, 1898.

² Diseases of the Breast, by A. Marmaduke Shield, 1898.

³ Lancet, February 5, 1898.

⁴ Diseases of the Breast, 1898.

1. When there is extensive involvement of the skin in the form of "cancer en cuirasse," or where numerous tubercles are scattered over the thorax.

2. When the supraclavicular glands are involved.

3. When carcinoma is found to exist elsewhere (spine, liver, or pleura).

4. When the axillary nerves are involved.

I believe, with Mr. Herbert Snow, that in most cases sooner or later the thymus gland is involved, the sternum becomes implicated, and the head of the humerus becomes infected. Involvement of these regions is due to the fact that the axillary glands are blocked and lymph regurgitates and flows in abnormal directions. Sternal involvement exists for months before it becomes evident, but when it exists even the most radical operation cannot cure. It is made manifest when it is marked by a bulging at the junction of the upper and middle thirds of the sternum and by pains in the scapula. The head of the humerus, when it is involved, is thickened and becomes tender.

Many surgeons will not operate on atrophic cases. Such cases may live for many years if not operated upon. W. Watson Cheyne, however, maintains that atrophic cases are the most favorable ones for operation and give the greatest chance of permanent cure.

AMPUTATION OF THE SHOULDER-JOINT. Lister suggested that in some cases in which radical removal seemed impossible it would become possible by amputating at the shoulder-joint, and he first tried the plan.

W. Watson Cheyne has well said that when the disease has advanced so far as to require amputation before it is possible to clear the axilla, there is not the slightest hope of curing the patient.

C. T. Dent¹ reported to the Royal Medical and Chirurgical Society of London a case of cancer recurring after the removal of the breast in which the entire upper extremity was removed by Berger's method. The patient recovered from the operation. We may say of amputation of the entire upper extremity what Cheyne says of the amputation at the shoulder-joint.

PALLIATIVE OPERATIONS. Occasionally the breast is removed when it is distinctly recognized that cure is not possible. Such an operation is justifiable if ulceration is about to occur or has occurred, especially if the ulcer has a foul discharge or the patient is the victim of harassing pains. In such an operation the attempt should be to make a wound which can be closed. It is questionable if a palliative operation prolongs life to any marked degree, but it makes the sufferer far more comfortable in mind and body, and usually permits of a more merciful death by visceral implication. A palliative operation should not be urged, but

¹ New York Medical Journal, May 21, 1898.

the truth of the matter should be placed before the patient and she should be left free to choose operation or refuse it. In some cases, instead of a palliative operation, it may be proper to try oöphorectomy, or, if this is refused, injections of alcohol.

TREATMENT OF INOPERABLE CASES. Reports make it certain that inoperable sarcoma, especially of the spindle-cell variety, is occasionally benefited, or even cured, by the use of Coley's preparation of the mixed toxins of erysipelas and bacillus prodigiosus.¹ Coley's fluid, however, is of no benefit, or of only slight benefit, in cancer, and the trivial possible gain does not counterbalance the risk attendant on its employment.

SERUM-THERAPY has been employed. Emmerich and Scholl take the serum from a "prepared" sheep, the animal being prepared by repeatedly injecting into it fluid of cancer. The value of this treatment is absolutely undetermined. Some French observers think highly of it, but Bruns and others have failed to obtain any benefit from the use of the method.

It has been alleged that good results may follow the local employment of aniline, but the method has been practically abandoned.

In some cases injections of alcohol, after the method of Hasse, will do good: Yeats reported a striking case in which a large carcinoma shrunk and hardened and the breast practically disappeared; this patient finally died of a cancer in the liver.² Alcohol, when injected into the tissues, hardens and contracts them, the bloodvessels and nerves are compressed, and, sources of nutrition being thus interfered with, the growth undergoes atrophy (Yeats). E. J. Koch³ thinks that the treatment is of value. Hasse's results have been remarkable, a number of cases having been cured, and in inoperable cases this method can be tried. The alcohol should be diluted with an equal portion of water, and once or twice a week one or two syringefuls should be thrown into the retromammary tissue.

OÖPHORECTOMY. Beatson, in the *Lancet* of July 11, 1896, suggested oöphorectomy and also the administration of thyroid extract in the treatment of inoperable carcinoma of the mammary gland. A résumé of Beatson's views follows: The secretion of milk is effected by the nervous system, but is not controlled by any special nerve supply. The changes occurring in the mammary gland during lactation are identical, up to a certain point, with those occurring in the development of cancer. In both there is epithelial proliferation; in both the new cells fill the acini and block up the ducts; but in lactation the epithelial cells undergo fatty degeneration and form milk, whereas in cancer the cells do not undergo

¹ William B. Coley. Denver meeting of American Medical Association.

² British Medical Journal, September 25, 1897.

³ Philadelphia Medical Journal, May 28, 1898.

fatty degeneration but invade the walls of the ducts and acini and also the surrounding tissues. In some countries it is customary to spay a cow after calving, in order to keep up the supply of milk, the removal of the ovaries apparently removing some influence which when present tended to prevent fatty degeneration of epithelium. There is evidence that the secretion of the breast is controlled by the ovary, and, if this be the case, may it not be that cancer of the breast is due to ovarian irritation, and may not the cells of cancer be caused to undergo fatty change by removing the ovaries? Beatson reported a very remarkable case which was cured, and another case in which a marked change took place in the growth. Stanley Boyd has reported two cases, in each of which, after removal of the ovaries, the carcinoma shrunk decidedly and pain was relieved.

W. Watson Cheyne¹ has reported two cases in which he performed this operation. In one case there was positive improvement, lasting, however, only a few months, and in the other case there was no benefit.

G. Ernest Herman² reports a case of recurrent cancer of the left axilla following extirpation of the breast. Exploratory incision showed that the mass was irremovable, so both ovaries were removed and the patient was placed upon thyroid extract. Fourteen months later the nodule above the clavicle and the axillary mass had disappeared and the patient was cured.

With such positive cases on record as those of Beatson and Herman, the operation is certainly justifiable, and in a case in which the radical operation is out of the question we should place the known facts as to oöphorectomy before the patient and let her decide the question. Shield says: "In cases of recurrent cancer in young women it may legitimately, after consultation, have a trial, and may perhaps prove of utility, especially in relieving pain."³

BRAIN SURGERY.

Idiocy. The surgical treatment of idiocy is futile, hopeful anticipations of a few years ago having failed of realization.

In 1878 Fuller, of Montreal, trephined the skull of an idiot for the purpose of improving the mental condition, and Lannelongue, of Paris, devised the operation of linear craniectomy and performed it upon a microcephalic idiot. Lannelongue's belief was that in microcephalus there is premature closure of the fontanelles and premature ossification of the cranial sutures, the rigid non-distensible brain-case preventing the expansion of a brain endeavoring to develop. Holding such a view as

¹ British Medical Journal, May 7, 1898.

² Lancet, June 11, 1898.

³ A. Marmaduke Shield. Diseases of the Breast, 1898.

to causation, it seemed entirely reasonable to maintain that by cutting a strip out of the skull the surgeon could permit the bones to expand and free the brain from a pressure which retards its development and hinders the evolution of the higher faculties.

The proposal was received with enthusiasm, has been extensively applied, and sufficient experience has accumulated to permit us to form positive conclusions as to its value. In discussing this matter it is well to bear in mind that by the term *microcephalus* we mean to designate a head the circumference of which is less than seventeen inches.¹ Unquestionably in some cases of *microcephalus* the fontanelles are closed at birth; in some few cases the sutures on the sides and summit of the skull ossify prematurely; in some very rare cases the premature ossification involves the face as well as the skull, the superior maxillary bone being particularly affected, and the teeth erupting too early (Jacobi).

The evidence against Lannelongue's view of causation is overwhelming.

The size of the head is not a measure of an idiot's intelligence, as some idiots with small heads have more mental power than other idiots with larger heads. Even if premature ossification exists we cannot recognize it. Bourneville, by a number of post-mortem examinations, proved that premature ossification is usually absent, in fact in some cases the sutures may be less advanced than is normal. Even when the sutures at the sides and summit of the cranium are prematurely ossified, the sutures at the base are usually behind the proper stage of development (Ireland, from Gratiolet).

Sir George Humphrey studied a number of skulls and found no evidence that deficient development of the skull is an element in the deformity. The brain shows no evidence of compression, and the convolutions stand out freely and are separated by distinct sulci. Humphrey believes that the skull grows upon and accommodates itself to the brain.

Mr. Joseph Griffiths² characterizes as hypothetical those cases reported in which it is alleged that a more or less normal brain is hindered in development by ossification of cranial sutures.

In some cases of *microcephalus* the spinal cord is small (*micromyelia*), but this analogous condition cannot be due to premature ossification of the vertebrae. In many cases the heart is small, and this condition obviously is not due to compression. *Microcephalus* begins before birth, the brain having ceased to develop about the fifth month, and this is proved by the absence of certain areas which should exist at birth. The skull is moulded to this small brain, to this ill-developed brain, to this

¹ W. W. Ireland on "The Mental Affections of Children," 1898.

² London Medical and Chirurgical Society. Reported in *Philadelphia Medical Journal*, April 2, 1898.

brain which contains too few nerve-cells, which cells are stunted and ill-formed. A microcephalic brain does not always remain simply ill-developed, but structural lesions often arise, and in many cases we cannot tell that such diseased conditions exist.

Very often there is general lack of development (idiot hand, deformed toes, absent bones in fingers, loose and inelastic skin, streaked tongue, short stature; rickets may exist; patient may be blind or deaf; it is rarely that puberty develops). Ireland tells us in his recent book that so many cases of microcephalus with open sutures have been collected that "no one will continue to hold that the small size of the brain is owing to the sutures closing in and hindering its growth." He adds, "even in those cases where the sutures have closed in before birth, the question still remains whether the brain ceased to grow because the sutures are closed, or whether the sutures closed in because the brain ceased to grow, and, lastly, whether both the brain and its coverings ceased to grow under a common cause." He states further that if the sutures closed in and the brain continued to grow, the symptoms of hypertrophy of the brain would be produced; but this is not the case. He concludes that the skull does not and cannot limit brain growth, and that the brain does not cause a normal skull to expand; "both grow harmoniously together under the influence of a formative force inherent in the whole organism which suits the size of the skull to the size of the brain" (Ireland).

It is thus made evident that the supposed cause of microcephalic idiocy, which cause we seek to remove by craniotomy, has no existence, but the operation is still occasionally performed.

Dr. Laplace¹ seeks to justify its performance on the ground that the imperfectly formed brain takes a greater amount of nourishment and improves in function after cutting a piece out of the skull.

Dr. W. W. Keen² is very conservative in his estimate of the value of craniotomy in microcephalus. He has operated upon eighteen cases, the youngest being eighteen months of age and the oldest six and a half years. Five of the patients died; in seven cases there was no benefit; in six cases slight improvement followed the operation, and in one case a mischievous idiot "became quiet and sleepful." Keen says no good can possibly come from the operation if performed on an idiot with a skull of average size, on a child with extreme microcephalus, or on a patient over seven years of age. Even when improvement follows the operation it is very slight, and much depends on education. Keen concludes that in some few cases of moderate microcephalus the operation is justifiable.

¹ Improvement of Brain Function by Surgical Interference. *Journal of the American Medical Association*, October 2, 1897.

² *Journal of Nervous and Mental Diseases*, February, 1898.

In a small number of cases slight improvement will follow, but in the majority there will be no change. In from 15 to 20 per cent. of cases "the operation will happily be followed by death."

Whereas little or nothing is to be expected of the operation so far as improving the mental condition is concerned, the procedure may be useful to relieve certain symptoms. Mr. Joseph Griffiths¹ insists on this, and believes that the operation may be beneficial if there is irritation of the motor cortex.

I believe it justifiable to present the following conclusions :

1. Microcephalus is not due to premature ossification of the cranial sutures any more than is micromyelia due to premature ossification of portions of vertebrae.

2. The brain in microcephalus is not a more or less normal small brain in which mental deficiency is due to the small size of existing parts. It is an undeveloped and often a diseased brain. Certain areas may be absent, and the cells are stunted and too few in number.

3. Idiocy is not a condition in which the brain alone is involved. It is a condition of general undevelopment.

4. Cutting a strip out of the skull cannot cause an undeveloped brain to develop ; it cannot lead to the production of new and normal cells ; it cannot cause the appearance of absent parts, and it cannot increase powers which are absent. It cannot develop the mind any more than it can develop an absent finger-bone, than it can make the skin elastic, or than it can restore sight to the blind.

5. The mental improvement so often reported after the operation is not due to it. Many cases are reported too soon. Some which have been reported as improved have not maintained the improvement. Some have been made worse (we have seen such a case in the Elwyn Institution for the Feeble-Minded). After such an operation a child is watched, placed under discipline, controlled, and directed. It may improve under the insistent care of strangers, just as it might have improved if taken from home and cared for in the same way, no operation being performed.

Idiots are liable to temporary maniacal outbreaks, and it often happens that a child is brought for operation because it has such an outbreak and has become particularly unruly. The temporary and unusual excitement may disappear after operation, the child returning to its former level of idiocy, and this return to the usual state is looked upon as an improvement of condition and is reported as due to operation. Even such an improvement is due to a combination of factors ; shock, the anæsthetic, but particularly regular, careful, and skilful control. The child, if sub-

¹ London Medical and Chirurgical Society. Reported in Philadelphia Medical Journal, April 2, 1898.

sequently trained and educated, is pointed out as an object-lesson of the great value of craniotomy, and the surgeon is regarded as a medical Mrs. Joe Gargery who has brought up a brain by hand.

6. In an uncomplicated case operation is not justifiable, and it can do no good. The mortality is not 2 per cent., as has been stated, but is from 15 to 20 per cent., and we have no right to maim or kill to attain a hypothetical advantage, merely because a parent wishes it. The proper treatment is hygienic and educational; the health of the body should be improved, and the few activities of the brain trained, regulated, and brought into certain channels.

7. If there are certain complications with microcephalus or any other form of idiocy, operation may be justifiable. It will not improve the mental condition, but may relieve the complication and thus give comfort to the patient. Among those complications are paralysis, muscular spasm, muscular rigidity, and epileptiform convulsions. Operation is justifiable in traumatic idiocy and in any case in which pressure-symptoms really do arise.

Traumatic Insanity. That head injury can be productive of insanity is certain; that it often is, is very doubtful. Kiernan estimates that 2 per cent. of all cases of insanity have been produced by traumatism, and if we accept absolutely the statements of relatives of a lunatic we will be obliged to believe that 2 per cent. is a gross underestimate; but we should not accept their statements unreservedly. The relatives of a lunatic are apt to claim that in his case traumatism was a cause, making this claim because they fancy that ordinary lunacy is a disgrace to the family, but lunacy from head injury is an entirely respectable affliction. Simply because the individual has, in the past, received a blow on the head or had a fall, even if a scar still exists, it is not proof that the insanity arose from traumatism, and merely suggests the possibility of such an origin. Even when traumatism can be set down as the probable cause, it is often but one of several causes, or is only an exciting cause acting upon a predisposed brain. In only a small minority of cases does it appear to be the single cause.

Even when an injury seems to be the cause of the insanity we must realize that it may produce its effect in different ways: it may do so by causing cerebral concussion, the waves of cerebro-spinal fluid damaging the cortex; it may act purely by inducing fear, or shock, or both; it can do so by damaging the brain materially; it may do so by producing fracture of the skull with depression, or by leading to nutritive perversions which may or may not be followed by organic changes.

Various lesions have been described as causative, and among them we may mention: Exostosis, adhesion of the dura to the bone or other membranes, adhesion of the membranes to the brain, cedema of the brain,

congestion of the brain, hyperæmia of the brain, inflammation of the brain or the membranes, cyst of the brain, pressure on the brain, sclerosis of the cortex. In a number of cases no causative lesions are discoverable. The great number of the assigned causes indicates that the true one has not been definitely recognized, and it is highly probable that in many cases the true cause lies in a subtle alteration in the chemistry of the nerve-cells, and there is no obvious causative lesion (Clevenger). Many of the alleged causative lesions are in reality only secondary conditions which have arisen during the progress of the case (Clevenger).

The symptoms of this form of insanity may appear soon or even at once after the accident; but they may not appear for months or even for years. In the cases which arise long after an accident, an expert would have been enabled to detect, as preceding the insanity and following the accident, a distinct change of character, irritability, alteration in the sentiments, and perversion of the emotions. The type of the insanity is not invariable in all cases. There may be stuporous insanity, mania with vivid hallucinations, melancholia with hypochondriacal or persecutory delusions, mental automatism, paranoia, paresis, and dementia either of the organic or senile type, and some cases are associated with epilepsy.

In spite of the possible variability in type there is one symptom-group which is especially common and which Spitzka and others name traumatic insanity proper. It is an evolution of a traumatic neurosis. Spitzka says it is characterized by a change of character, immorality, a tendency to drink excessively, suspicion, brutality, a quarrelsome disposition, violent and ferocious impulses, brief outbreaks of excitement, and hypochondria. The condition may last for years, with numerous episodes of apparent lucidity, but ends at last in dementia. Various physical signs are usually present in traumatic insanity proper: headache of a pulsatile nature, tinnitus aurium, scintillations and colored spectra, vertigo, paresis of groups of muscles, and impairment or perversion of sensibility.¹

The cases which come on soon after the injury give the best prognosis. Those which come on months or years after give a very bad prognosis.

Many surgeons have operated for this condition, but the exact value of the operative treatment is hard to estimate for several reasons. Some surgeons have been over-confident and enthusiastic, and would trephine most lunatics and many criminals. As an instance, it has been said: "A lesion must exist, and it is the surgeon's duty to try and find it," as if the lesion were a lost watch and the surgeon a detective with a search-warrant.

Most cases have been so very badly reported that the reader cannot tell what the symptoms were, what the history and hereditary tendencies

¹ Spitzka. *A Manual of Insanity.*

were, and what were possible predisposing causes. In fact, in some cases it has not been made clear that the patient was even insane. It is probable that some cases of ordinary traumatic neurosis have been operated upon, and so have cases of cerebral syphilis. One surgeon describes the mental condition by saying: "Patient could not think much, only to a certain point." Another says: "Immediately after operation patient began to follow out ideas." In some cases said to have been cured by operation no regard has been paid to the possible effect of nervous shock, of the influence of the anæsthetic, and of the curative influence of the operation *per se*.

We believe that a small percentage of insanities are due to traumatism, and only in a small number of these is there a recognizable primary lesion. Most reported cases have been acute, with unsystematized delusions, or chronic, characterized by periodic outbreaks, just the cases which may be cured by medical means and proper care, by shock, or by an intercurrent malady. A cure from the shock of an operation is apt to be a sudden one, and hence is not apt to be enduring. Many of the reported cases were not really cured; others were not cured by the operation; some were never insane, and others would have been cured as easily by being thrown down stairs, and more easily and certainly by medical means. Nevertheless, in some few cases a surgical operation is indicated and may do much good. We should operate upon cases in which the site of traumatism is indicated by a scar, a depression of the bone, a fixed and persistent pain, or some distinct localizing symptoms. In some few cases it is justifiable to trephine for the relief of intracerebral pressure, although trephining in such a case is only palliative.

After speaking of so many ill-reported cases it is a pleasure to turn to the recent article of Damer Harrison,¹ in which he reports clearly three successful operations for traumatic insanity, and points out when operation is indicated. The entire article is worthy of careful attention. In the reported cases operation was urgently demanded, as the patients were getting worse and worse.

Harrison believes that mental impairment after head injury is more common than has been supposed. He has seen four cases after fracture of the base of the skull, one case after a bullet wound, and three cases after fracture of, or blows upon, the vault. He agrees with Macewen that patients with head injuries may recover without interference, and yet later develop mental defect, and that in many instances operation in such cases will prevent these unfortunate sequences. Harrison quotes the sixty-seven cases collected by Dr. A. H. Powell and adds to the list ten more, including three cases of his own, making seventy-seven in all.

¹ Liverpool Medico-Chirurgical Journal, July, 1898.

Only seven had been operated on immediately after the accident, yet forty-eight still showed depression from fracture, and in seventy-four cases operated upon there were five deaths.

In fifty-seven cases during the last two years there were two deaths, fifty-one mental recoveries, twelve in which there was great improvement, five in which there was slight improvement, and four in which there was no improvement. In one of these last four there was no indication for operation, and in three of them there was temporary improvement followed by relapse.

In only four cases was the dura opened (including two of his own).

Lesions found: In thirteen cases there were no particulars recorded. In eight cases nothing abnormal was found, and six of these completely recovered. In forty-eight cases there was depressed bone; beside the depressed bone, in thirteen there were osteophytes and splinters from the inner table; in nine there was thickened bone; in three were dural cysts; in one thick bone with subdural and subcortical cysts; in one diseased bone; in one a bullet in the dura. In twenty cases there were cicatrices or sensitive spots, and in two of them splinters or osteophytes; in six of them thickened bone; in one of them a serous cyst, and in one (his own case) adhesions between brain and dura. In all of the collected cases the dura was adherent in fourteen and the pericranium in two cases.

Harrison concludes that 2 per cent. of cases of insanity are due to traumatism, but only a few of these can be relieved by operation, as operative interference is only justified by local indications at a spot readily accessible.

CASE I.—Harrison's first case was a man fifty years of age. Over a year before he had been struck with the handle of a windlass, the blow resulting in a scalp wound and a bone fissure. Some time after the accident he developed giddiness, and on several occasions lost consciousness and fell to the ground, but never had a convulsion. During the second year after the injury he became restless, irritable, giddy, labored under fits of depression, and developed persecutory delusions (thought people were following him), and had hallucinations (saw faces peering at him through the windows). The eyesight became impaired, and he had two outbreaks of homicidal impulse. The skull was trephined; the bone was thick. A depressed cicatrix was found over the second frontal convolution; a subdural cyst was opened and drained. He was discharged, in sixteen days, well, and has remained so ever since.

CASE II.—A man, twenty-six years of age, four years before had received a severe blow on the left frontal region. From the time of the accident he had suffered from attacks of violent headache; when seen by Harrison he was very suspicious, had attacks in which he ran in the street and created disturbances; when he got headache he became

delirious, and subsequently had no memory of the days of the outbreak. The grasp of the right hand was weak. A small scar existed in the left frontal region, and percussion on the scar caused pain. The skull was trephined and the dura was opened. Adhesions were found between the dura and second and third frontal convolutions. Button was not replaced. The day after the operation there was slight paralysis of right side of face and some motor aphasia, but all evidences of insanity had disappeared. On the fourth day he had a slight fit, and during the next thirteen days had a large number of Jacksonian fits. For a considerable time had some anaesthesia of right side. At the present time the arm only is anæsthetic. There is no memory of a period of at least four months preceding operation, but all evidences of insanity have passed away.

The author says that a large opening should be made in the bone, and expresses himself as uncertain if adhesions cause trouble by dragging on the cortex or by causing circulatory disturbance of centres.

CASE III.—The third case had been struck on the occipital region and had developed hallucinations of sight and suicidal tendencies. Adhesions existed between the cicatrix and bone. Recovery followed operation.

Post-operative Insanity. R. Harvey Reed reports two cases of post-operative insanity,¹ the first of which was acute mania and occurred in a woman free from hereditary predisposition, who had been operated upon for lacerated cervix. No infection followed the operation, and the mania, which began after an apparent recovery from operation, lasted for three months. The second was that of a woman who developed profound melancholia after removal of the uterus and ovaries. Both cases recovered.

As is well known, insanity may follow upon an operation, an injury, or the administration of an anæsthetic. Such cases are most apt to occur in those who are predisposed to insanity, but may arise in individuals who are apparently free from hereditary or acquired taint. Post-operative insanity is met with most often after operations upon the female genital organs, especially trivial plastic operations, like repair of a lacerated cervix or perineum. The condition is not due to infection of the wound, it is apt to arise suddenly and presents marked symptoms, and the type may be melancholia, mania, or dementia, but fixed delusions are rarely met with. The most usual condition is a state of active delirium, with changing, unsystematized delusions, frequently of the persecutory variety, hallucinations of sight and hearing, insomnia, and great mental confusion. Some few patients die, the majority recover

¹ Denver meeting of the American Medical Association, 1898.

completely, and in a very few the insanity becomes chronic. The condition must not be confounded with the mental aberration which may be produced by iodoform poisoning, in acute cases of which the symptoms arise suddenly, and the patient suffers from nausea, a metallic taste in the mouth, and fever; there are acute delirium, vivid hallucinations of sight and hearing, the pupils are contracted, the conjunctivæ and skin are yellowish in hue, there is often a cutaneous eruption resembling measles, the breath smells of iodoform, and the drug can often be found in the urine.¹

In some rare cases the symptoms arise more gradually, and consist of irritability, depression, confusion, unsystematized persecutory delusions, followed by stupor or coma.²

Post-operative insanity must be differentiated from febrile delirium, delirium of sepsis, uræmic poisoning, delirium of pneumonia, delirium of alcoholism, salicylic acid poisoning, carbolic acid poisoning, and post-febrile insanity.

It is maintained by many alienists that removal of the ovaries is particularly liable to be followed by post-operative insanity.

Howard Kelly, in the second volume of his *Operative Gynecology* (1898), discusses the subject of post-operative insanity. He has seen six cases of insanity following operations upon the perineum, and one of them died of acute mania. A patient who was operated upon for lacerated cervix and relaxation of the vaginal outlet committed suicide after returning home. A colored woman who, laboring under uterine cancer, had been curetted died in an asylum. He has seen insanity follow abdominal section in eight cases out of over two thousand (0.5 per cent.).

Kelly's conclusions are as follows:

The insanity may immediately follow operation or develop after an interval of days or weeks; the condition is not caused by sepsis, by exhaustion from hemorrhage or prolonged operation, nor by violent pain; it may ensue upon a very simple operation, and the removal of the ovaries and tubes has no special causative influence more than any other operation; the majority of cases are neurotic and hysterical women who have been very apprehensive regarding the operation; in some cases there is great vesical irritability; there is a strong predisposition in those who have previously been melancholy or insane, and such cases should only be operated upon when it is absolutely necessary, and then only after explaining to the family the risk; recovery may be attained in a few weeks or after a much longer period, or the insanity may become permanent. Of Kelly's eight cases five recovered, two remained insane,

¹ A Manual of Modern Surgery, by John Chalmers Da Costa, June, 1898.

² Ibid.

and one committed suicide after returning home. Kelly quotes the analysis of Charles P. Noble's sixteen cases.

Tumors of the Brain. Ten years ago surgeons as a class became imbued with the conviction that a way had at length been found to treat successfully tumors of the brain by operation. In the period which has since elapsed many operations have been performed, but the rosy anticipations have not been realized in the results, and, as a consequence, a conservative reaction has set in, and the indisposition to operate in such cases seems to be growing. A review of what has been learned on the subject scarcely seems to countenance the ultra-conservative view. In considering the question of operation for brain tumor we should always bear in mind that we are discussing a disease which will be practically always fatal without operation, unless the tumor be syphilitic. This point was justly emphasized by Ferrier in his paper read before the British Medical Association in Edinburgh.¹ Ferrier says that whereas in other parts of the body tumors are classified as benign and malignant, yet every intracranial tumor is "virtually malignant," this special malignancy consisting in the injurious pressure which it exercises on the cranial contents. Ferrier says further that medical treatment, except in gummata, is useless, or at best but palliative, that cerebral tumors with very few exceptions are progressive, and that the diagnosis of tumor is a sentence of death if operation is not performed.

W. W. Keen cordially agrees with Ferrier, and in spite of the serious nature of such operations is of the opinion that they offer what is practically the only hope.

The custom, when a diagnosis is made of tumor of the brain, is to put the patient on a course of iodide of potassium.

This should be done, of course, if we suspect syphilis, but it may also be done even when we have no reason to suspect syphilis, because syphilis may be present when we do not suspect it, and also because a course of iodide may occasionally relieve the symptoms which are caused by a non-syphilitic tumor. Ferrier mentions this last fact, and F. X. Dercum² alludes to glioma as a form which may be benefited. Mercurial injections should be applied while iodide is being taken, and iodide should be given in advancing doses until a large amount of the drug is taken daily. J. Michell Clarke's³ rule is as follows: If it is certain there has been no syphilitic infection, and if the tumor can be accurately localized, operation should be promptly performed; but if there is any doubt as to the existence of syphilis, or if the tumor cannot be localized, or if it is in an inaccessible position, then iodide should be given.

¹ "The Treatment of Intracranial Tumors," by David Ferrier. *British Medical Journal*, October 1, 1898.

² *British Medical Journal*, October 1, 1898.

³ *Ibid.*

How long should iodide be given before we abandon it as useless? Keen thinks that six weeks is the longest desirable period, Victor Horsley says three months.

It does not do to delay operation too long if improvement does not occur under iodide, as delay may be a fatal waste of time. Joseph Collins¹ is persuaded that valuable time is often lost in giving potassium iodide, and when there is no history and no sign of syphilis the tumor should be promptly removed.

Syphiloma may not be benefited by specific treatment; in fact, as Waterhouse² shows, tumor symptoms in such a case may get worse under treatment, the gumma actually increasing in size. He cites such a case, in which, after the utter failure of anti-syphilitic treatment, he removed a large gumma from the left Rolandic region.

Bramwell maintains that in some cases which present symptoms of cerebellar tumor, and in which recovery ensued, no tumor existed, the condition having been simply overdistention of the ventricles, with blocking of the foramen of Magendie, resulting from meningitis. Bramwell cites three post-mortem cases to prove this point.³

A correct diagnosis is the physician's most important duty, and it is by no means always easy. In fact, in some cases after a positive diagnosis of tumor a post-mortem shows there is no tumor, and in many cases after a positive localization a surgeon operates and fails to find the tumor at the point indicated, or fails to find it at all. "The basis of all operations aiming at curative or palliative results must necessarily be accurate diagnosis, not only of the existence of an intracranial tumor, but also of its nature and location."⁴ Very few brain tumors can be removed surgically, and in many cases where operation has been performed no tumor has been discovered. Some years ago Bramwell stated that he had seen eighty-two cases of brain tumor during life, and in seventy-seven of these cases operative interference was contraindicated. Since Bramwell wrote the above-mentioned article he has seen forty-one additional cases; fourteen cases were operated upon, but in not one case was the tumor removed,⁵ and his experience in 123 cases is that in five the tumor might possibly have been removed.

Von Bergmann⁶ stated that in the last few years he had operated six times for tumors of the brain; in five cases no tumor was found; in the sixth case a tumor was found, but could not be removed. In 72 per cent. of reported cases no tumor was found on operation. The same author states⁷ that tumors of the central convolutions are most easily

¹ British Medical Journal, October 1, 1898.

² Ibid.

³ Ibid.

⁴ MacCormac. Ibid.

⁵ British Medical Journal, October 1, 1898.

⁶ International Medical Congress at Moscow.

⁷ Volkmann's klinische Vorträge, December, 1897.

diagnosticated and most readily removed; that tumors of the temporal, parietal, and occipital lobes can be diagnosticated only when they grow into, press upon, or infiltrate the central convolutions and disturb the motor centres.

In 1896 Starr collected the records of 162 cases operated upon.

It seems a fair estimate to conclude with Starr that in 100 operations for brain tumor the growth will be found in seventy, but in only seven will it be removable.

Operation is not always performed with the distinct intention of removing the tumor. It is often performed for exploration, the intention being to see if there is a tumor at the suspected spot, and to remove it if removal is feasible; it is often performed purely to relieve pressure. In some cases partial removal is of great benefit to the patient, for it relieves intracranial pressure, makes the patient much more comfortable, and, Victor Horsley believes, serves to retard the growth of the portion of tumor which remains. Operation is often beneficial when no attempt is made to remove the tumor.

Improvements after simple trephining, with opening of the dura, have been reported by many surgeons, and this operation frequently relieves the symptoms for a considerable time (headache, epileptic attacks, optic neuritis, stupor, respiratory failure).

Bramwell believes that simple trephining is often advantageous; Anandale believes in it strongly, and Starr considers it to be a justifiable procedure.

Ferrier¹ advocates exploratory operation, because exposure of the tumor may show that the growth is removable, and because, even if irremovable, the operation may greatly improve the condition by lessening pressure and "freeing the patient from his apathy or stupor, his headache, his vomiting, his optic neuritis and risk of blindness."

Ferrier concludes that the "risks of operation are less serious than the evil of allowing a case to perish, which the necropsy might prove to be one that might have been dealt with successfully." Of course, an exploratory operation may prove fatal, and may, in some cases, be followed by hernia cerebri.

C. E. Beevor² believes in the value of trephining and opening the dura when the tumor cannot be localized, or when it is too extensive to be removed or so situated that it cannot be removed. If the position of the growth cannot be determined, he thinks we should trephine over the occipital region, puncture the lateral ventricle, and drain. If the tumor has not been located, but there is localized headache or pain on percussion, the trephining should be performed at this point. If there is

¹ British Medical Journal, October 1, 1898.

² Edinburgh meeting of the British Medical Association.

neither localized headache nor tenderness, the trephining should be performed, as Ferrier advises, in the occipital or frontal region.

S. P. Kramer recently reported a case in which striking improvement followed the removal of bone and opening the dura.¹

Herbert F. Waterhouse and others reported cases to the British Medical Association in which astonishing improvement followed trephining.²

Some surgeons advocate relieving pressure by the frequent employment of lumbar puncture.

The mortality of operations for tumor of the brain is large, but this should not deter us, as it is no larger than that of many other major operations, and not so large as that of some. The condition, if uninterfered with, will produce death, often a painful and lingering death. Operation, according to Ferrier, is completely curative in 13 per cent. of cases, greatly relieves the symptoms in over 50 per cent., and produces death in 36 per cent.

The propriety of removing gummata and tubercular tumors by surgical operation has been much disputed.

Many gummata can be diminished or removed by medical means, but in not a few cases medical treatment fails utterly, and if an operation is not performed the patient will certainly die. The opinion of many of the speakers at the Edinburgh meeting of the British Medical Association was that if specific treatment fails to relieve the symptoms an operation should be performed. Schlesinger³ has recently discussed this matter. He considers that operation is particularly indicated if the symptoms do not improve or if they become worse under specific treatment; if the growth is in an accessible region; if it is not very large, and if Jacksonian epilepsy arises, even if other tumor symptoms improve. He holds that operation is contraindicated if there is spinal syphilis, syphilis of the base of the brain, amyloid disease, or great vital exhaustion.

In tubercular tumors improvement may follow general treatment; but in some cases it is proper to attempt removal. Removal is useless if there be basal meningitis, if there be multiple tubercular foci, or if diseased areas exist in distant parts.

Diagnosis of cerebellar tumors is more uncertain than of cerebral tumors, and operations are less often satisfactory.

The following conclusions seem to be justified:

1. Almost every brain tumor except syphiloma, if not operated upon, produces death, and even a syphiloma is often fatal. Hence, practically every brain tumor, except a gumma, demands operation, and even a gumma may call for it.

¹ Proceedings of Cincinnati Academy of Medicine, 1897.

² British Medical Journal, October 1, 1898.

³ Wien. klin. Wochenschrift, January 27, 1898.

2. When the diagnosis of brain tumor is made and the patient is not *in extremis*, he should be placed upon advancing doses of iodide of potassium and be given mercurial inunctions. Syphiloma will generally but not always improve under this treatment, and glioma may improve temporarily.

3. If distinct improvement does not follow in six weeks after the administration of iodide and mercury, an operation should be performed.

4. If a patient is *in extremis* (stuporous or comatose) an operation should be performed at once, as to delay to give specific treatment may prove fatal.

5. If an operation is determined on, even if the situation of the growth has been, as is thought, ascertained, the surgeon should bear in mind that localization may be fallacious, and that every operation for brain tumor is, and must be, exploratory. He trephines over the supposed seat of tumor, enlarges the opening with a rongeur, opens the dura, and explores. If he finds the tumor he determines if it is removable, and if he decides it is, he removes it. If he can only remove part of it he does so. If he cannot remove any of it, or if he does not find a tumor, he yet remains satisfied that the operation was justifiable and may benefit the patient.

6. The tumors in which removal is most easy are those in or near the cerebral cortex. Tumors of the cerebellum can be removed. Tumors near the base cannot be removed. Encapsulated tumors are removed most easily. Disseminating tumors are often irremovable.

7. If the tumor is regarded as irremovable because of its size, situation, and nature, or because there are multiple tumors, or if the growth cannot be localized, trephining should be performed: first, for exploration, as the preoperative diagnosis may be wrong; second, to lower cerebral pressure and to improve the patient's condition.

THE SURGICAL TREATMENT OF EPILEPSY.

The surgical treatment of epilepsy has been extensively employed, but it is distinctly disappointing, for, while almost any operation may benefit a patient for a time, there is no operation which will certainly cure. All sorts of operations have at times been suggested. Among these we can mention circumcision, castration, ocular tenotomy, oöphorectomy, clitoridectomy, removal of spurs from the nasal septum, ligation of the vertebral arteries, removal of the cervical ganglion of the sympathetic, removal of scars, and trephining of the skull.

In considering the question of operation, epilepsy should be divided into *traumatic* and *non-traumatic*, and traumatic epilepsy is divided into those cases in which there is evidence of injury over a known centre

and those in which the injury is over a latent area of the brain. If the injury was over a known centre, and if muscular spasms begin in the group of muscles controlled by this centre, or muscular paralysis exists in the group, the skull should be trephined, the dura opened, and the centre removed. It is justifiable to operate over latent brain areas. Before trephining a skull for a case of epilepsy in which no cortical lesion can be localized, it is always wise to remove any peripheral sources of irritation. If depression of bone exists, or if the fits are of the Jacksonian type, the skull should be trephined and the dura opened. When a brain area has been excised, paralysis ensues in the muscles governed by the portion of cortex removed. In some cases the paralysis is permanent, in others it disappears except for the finer movements. When an area of irritation has been removed from the cortex (a tumor, an area of sclerosis, a portion of apparently normal cortex), a scar forms, and the scar becomes a distinct source of irritation and often reproduces the fits.

In estimating the value of operations for epilepsy we must remember that any operation may stop the fits for a time. J. William White,¹ some years ago, reported ninety cases in which the skull was trephined; nothing abnormal was discovered, but in all the cases there was great temporary benefit, and in two cases apparent cure. White then mentions instances in which improvement or cure followed ligation of the carotid artery, an accident which crushed the testicle, tracheotomy, and so on. The curative effect of such surgical operations or accidents seems to depend, at least in part, upon the interruption of the epileptic habit by shock.

In non-traumatic epilepsy the fits must be studied by a trained observer, and if they are found to be of the Jacksonian type, the cause of irritation or the irritated centre can be excised (remove a tumor, drain an abscess, take away an exostosis, dissect out a cyst, remove an area of sclerosis or the irritated but apparently normal centres). The surgeon should be careful to remove as little of the cortex as is possible, because paralysis will follow. The fear of paralysis need not deter us, as it is a condition which will improve and which at any rate is preferable to spasm. McCosh² says that post-operative lesions do occur, but he thinks their importance has been overestimated. Such lesions, he says, rarely irritate when the operation is done for recent traumatism, but they may irritate an abnormal brain. Such operations are rarely really curative, but they often arrest the fits for some time, and also render the patient more amenable to medical treatment.

¹ *Annals of Surgery*, August and September, 1891. "The Supposed Curative Effect of Operations, per se."

² *American Journal of the Medical Sciences*, May, 1898.

We have said that operations for epilepsy are rarely curative. Von Bergmann cured but two cases out of fifty operated upon.

In a recent article upon the "Surgical Treatment of Epilepsy," by Andrew J. McCosh,¹ the matter is reviewed in a most judicial spirit. The author tells us that the profession is very sceptical as to the beneficial results of operations upon the brain and its membranes; that the results of such operations are by no means satisfactory; that diagnostic mistakes are frequent, and that permanent recovery is extremely unusual.

It is true that many favorable statistics have been published, but, in common with most trained observers, McCosh considers that statistics represent the matter too favorably, though he thinks, nevertheless, there is hope that in a small number of cases benefit may follow operation, although in the vast majority of cases this is not to be expected.

Just as in the reports on removal of the breast for cancer many cases have been reported too soon, so in the reports upon epilepsy the same mistake has been committed. McCosh, in the above-mentioned article, holds that a report of cure is not convincing unless made at least three years after operation, as fits have been known to return after two years. Because of the horrible nature of the disease, the inevitable progress, and the wretched conclusion, I believe that operations are justifiable in traumatic cases and in cases where we can make a localizing diagnosis.

Sachs and Gerster advise operation in cases of partial epilepsy when not more than two years have passed since the infliction of a causative injury or the beginning of a causative disease, but, if there be depression or any other skull injury, they consider that operation is justified even years after an accident. In cases in which there is skull injury, simple trephining may be enough (Sachs and Gerster). If the symptoms have lasted but a short time, and indicate the existence of a circumscribed area of cortical disease, it is proper to remove a portion of the cortex (Sachs and Gerster).

Operation is useless in essential epilepsy and in any epilepsy which has existed for years and is not associated with bony depression or bone disease, although, even in such cases, trephining may be justifiable to relieve intense and persistent headache.

Even when a lesion is removed a case may not be benefited, because the lesion has produced irreparable mischief.²

McCosh lays down the following rules: Operate in:

1. Focal or partial epilepsy (Jacksonian) where convulsions are limited to a particular group.
2. In epilepsy, general or partial, where the condition has followed, or was apparently caused by, traumatic depression.
3. In many cases where partial epilepsy has followed a head injury,

¹ American Journal of the Medical Sciences, May, 1898.

² Ibid.

even if there are no external indications, but in which signal symptoms indicate the brain area affected.

McCosh made a report upon twelve cases of epilepsy operated on over three years ago. Three were cured, five improved, four unimproved. These figures are better than those of Sachs and Gerster, who reported nineteen cases of focal epilepsy operated upon, with three cures.

Graf has made a study of 146 reported cases in which trephining was performed for traumatic epilepsy.¹ In seventy-one cases simple trephining was practised, with or without opening the dura. In seventy-five cases the pia and cortex were operated upon. Fifty-six of these were for the removal of bone fragments, excision of cysts, scars, etc., and in nineteen of the seventy-five cases a portion of the cortex was excised. In the 146 cases there were nine deaths caused by the operation (6.1 per cent.). Only ninety-three of the cases could be used for statistical purposes, and of these thirty-six were not improved, twenty-two were improved, and thirty-five were well six months after operation.

In the light of the published experience of many surgeons we can conclude that :

Cerebral operations for the treatment of epilepsy, employed in carefully selected cases, may cure a small number of them and may temporarily improve many. In some cases it is proper to operate for infantile cerebral hemiplegia. The cases selected for operation are "localized epileptic seizures due to injury or to an unknown cause (idiopathic), if limited to one limb, two limbs, or two limbs and the face of one side."² In most cases the improvement is very transitory, but in a few it lasts a year or more. The prognosis is far better in traumatic than in non-traumatic cases. The percentage of cures is uncertain; Von Bergmann doubts if cure is ever obtained, but McCosh obtained it in three cases out of twelve.

The operation is not dangerous (mortality of 5 per cent. to 7 per cent.); in selected cases it should be performed, and the earlier it is done after the beginning of the case the better the prognosis. In some cases an exploratory operation is justifiable. In cases in which a great number of Jacksonian fits are recurring, operation may save life. As Dr. Nancrede has pointed out, the removal of a discharging centre eliminates but one element of the disease, and for a long time after such an operation the individual must avoid all muscular effort or mental excitement which could produce congestion of the cerebrum.

The excision of a centre will cause paralysis, which may be enduring; but, as Edward D. Fisher says, in many cases some paralysis exists

¹ Arbeiten aus der Chirurgischen Klinik der Königl. Universität. Berlin, 1898, xiii.

² Edward D. Fisher. Paper read before Alumni of Bellevue Hospital, January 5, 1895.

before operation, and operation only adds to it. Various methods have been employed to prevent subsequent adhesions between the dura and cortex, but none of them is quite satisfactory (interposition of rubber tissue, gold foil, tin foil, sterilized lining membrane of an egg-shell).

The fact that brain operations are often unsatisfactory, and are always so in essential epilepsy, has led surgeons to try various other plans. Among the methods which have recently excited some interest is removal of the superior cervical ganglion of the sympathetic. Julius Donath has recently made a report upon this operation.¹ In three cases he removed from either side the superior ganglia. He did this operation because it has been shown that irritation of the sympathetic in an animal can produce convulsions, and because he believed that the beginning of a convulsion consists in vasomotor spasm. In not one of these cases did the operation prove of benefit. Jonnesco advises complete bilateral resection of the superior cervical sympathetic ganglion for the treatment of essential epilepsy.²

The wisdom of founding an operation upon a hypothesis is at least questionable. That the pallor of the face which is present in the beginning of an epileptic attack is accompanied by anemia of the brain has been doubted by many. If Leonard Hill is correct, and there are no vasomotor fibres in the brain, anemia of the brain does not accompany the pallor of the face. Jaboulay has made another remarkable suggestion, namely,³ that the pneumogastric nerve be stretched for epilepsy. The patient upon whom he operated had fits preceded by a marked epigastric aura, and was having twenty-five convulsions a day. The operation, Jaboulay states, was apparently curative, and he also says that the pneumogastric may be stretched and the sympathetic sectioned, the cardiac effect of stretching the pneumogastric being counteracted by dividing the sympathetic.

We confess that we cannot grasp the utility of such procedures as removing the cervical ganglia or stretching the pneumogastric. It is surgery too profoundly scientific to be safe or successful. It is founded upon hypothesis, not even upon theory. It deals with some controverted points of physiology as though they were mathematical certainties. It seeks to alter stimulation and to affect inhibition, as though we knew all about such influences, could record their force with a gauge, measure their area with a rule, and trace their direction with unfailing precision. That improvement may follow such operations is not remarkable, for, as has been already mentioned, improvement may follow any operation, may follow an accident, or may follow the administration of an

¹ Wiener klin. Wochenschrift, 1898, No. 16.

² Revue de Chirurgie, No. 11, 1897.

³ Lyon Médicale, April 17, 1898.

anæsthetic. We have, as yet, seen no evidence which has convinced us of the value of such procedures, but will be freely open to conviction if the evidence is, in the future, presented. We believe that in taking this stand we express the views of many surgeons who are anxiously hoping for a method to cure epilepsy, but up to the present time find it only in cerebral operations, and find it in them with extreme rarity.

ABSCESS OF THE BRAIN.

Unquestionably the most impressive advance in the surgery of the brain is the operative treatment of intracranial suppuration. Von Bergmann considers that the successes obtained in this field constitute the most notable achievement in cerebral surgery. Cerebral abscess is rare before the age of five.¹ It is a secondary, not a primary, condition, and may arise as a sequence to injury, inflammation, or caries or necrosis of the bones of the cranium, suppuration of the scalp, inflammation of the membranes of the brain, wounds of the brain, suppurative conditions of the orbit and middle ear, operations upon the nose, and purulent conditions of the lung and pleura. Over one-half of all cases are due to middle-ear disease. In general, it may be said that a brain abscess causes some symptoms of pus formation, general pressure symptoms, and in some cases focal symptoms, the existence of the latter depending upon the situation of the abscess. The symptoms are often very obscure unless we obtain the history or observe the evidences of an antecedent causative suppuration. The history is of the greatest importance. The diagnosis must be made from meningitis, extradural abscess, infectious sinus thrombosis, pyæmia, and often from mastoid disease. In adults the case may be ushered in by a chill, followed by a temporary fever, but the temperature is apt to become normal or subnormal. In children, according to Holt,² there is fever.

In abscess from injury the symptoms usually appear within two weeks of the accident. Holt assigns the same period for the evolution of symptoms in infants.³ In adults, however, symptoms may arise at a much later period, as in Weir's case.

Abscess of the brain, if unoperated upon, shows a mortality of practically 100 per cent. If operated upon the mortality will be large, but not a few will be saved. The disease is a surgical emergency, and the indication to operate is imperative, as it is in strangulated hernia, acute intestinal obstruction, or blocking of the larynx or trachea.

In every case in which a diagnosis is made of abscess of the brain, operation should be performed. In operating it is well to remember that

¹ Holt. *Archives of Pediatrics*, March, 1898.

² *Ibid.*

³ *Ibid.*

an anæsthetic possesses special dangers in such cases, and the patient is particularly liable to stop breathing. If absolute coma exists an anæsthetic can be dispensed with, and in any case we should give as little of it as possible and always operate with aseptic care, because of the great danger of cerebral softening and suppurative meningitis (Jacobson). If there are localizing symptoms the area which they indicate is explored, remembering that the centres affected may not be the seat of abscess, but may be influenced by the pressure of an adjacent collection of pus. Holt points out that focal symptoms may mislead, because they may be due to an associated meningitis,¹ and he says that in children we must only trust motor symptoms. In some cases the proper place to trephine will be indicated by a scalp wound, an area of bone disease, or a fracture. If there are no localizing symptoms, and no signs or conditions to point out the probable situation of the abscess, it may be justifiable to trephine for exploration. After trephining for abscess the trephine opening is enlarged by the use of rongeur forceps, the dura incised, the brain inspected, and the pus sought for by introducing a grooved director. Every operation is really exploratory, for we are never absolutely sure as to the situation of the pus. After finding pus the track made by the director is enlarged by the insertion of the blades of a hæmostatic forceps carried in while closed, and withdrawn while somewhat opened. A large rubber drainage-tube is carried into the abscess cavity, and its other end is allowed to project beyond the scalp. This tube is sutured to the scalp. The abscess cavity should be irrigated with hot normal salt solution. The dura is partially sutured around the tube, and the scalp wound is sutured.

The majority of brain abscesses encountered by surgeons arise from middle-ear disease, the intracerebral pus collection being secondary to caries of the roof of the tympanic cavity or suppuration of the mastoid cells.

Middle-ear disease is a perpetual menace to the life of the afflicted individual, who is in peril every hour, and yet we frequently hear parents state that they thought a child would "grow out" of a running from the ear. It should always be treated by an expert, and if the mastoid is involved it should be opened, scraped out, and drained. Some surgeons are not so radical. Polo opens the mastoid at once if cholesteatoma forms, but in other cases does not open it unless there be a circumscribed swelling over the mastoid or cerebral symptoms arise.² When to open the mastoid has been greatly in dispute. E. Rimini³ says decision is easy when mastoid disease results from chronic otitis media, but is difficult in acute otitis media. He states that in every case of acute otitis there is mastoid

¹ Archives of Pediatrics, March, 1898.

² Gaz. Méd. de Nantes, July 2, 1898.

³ Berliner klin. Wochenschrift, March 14, 1898.

tenderness, but this fact alone does not justify opening the antrum. Rimini maintains that if, during acute otitis, the mastoid tenderness increases, spontaneous pain exists, mastoid oedema arises, and there are headache, fever, and possibly chills, an operation should be instantly performed. I believe it is dangerous to temporize. Mastoid operations are not entirely safe, but the more thorough they are made the safer they will be. An incomplete operation is apt to be followed by abscess. We have observed this sequence in two cases. A complete operation performed early prevents abscess. We follow the rules laid down by Rimini in acute otitis media. In chronic discharges operate if there is evidence of mastoid disease, and in doubtful cases explore. Brain-abscesses resulting from ear disease rarely cause localizing phenomena, but the seat of such abscesses is reasonably constant, and exploration will usually discover one. In most cases the collection of pus is in the temporo-sphenoidal lobe, in some cases it is in the cerebellum, or it may be in the lateral ventricle. When middle-ear suppuration exists and we even suspect the existence of abscess, an exploration should be made to determine the question. Bramwell believes that when definite and distinct cerebral symptoms exist, with middle-ear suppuration and a running ear, we should trephine for exploration, even if the cerebral symptoms do not clearly indicate that an abscess exists. It is quite true that headache, vomiting, and even convulsions may exist in connection merely with ear disease or mastoid suppuration; but they are much more apt to be produced by meningitis or abscess. If choked disk exists it points strongly to the existence of abscess, but does not prove it. In cases of doubt some surgeons are accustomed to treat the ear disease and the mastoid suppuration, and then await developments; but I believe such delays are dangerous, and think that in doubtful cases the ear and mastoid should be treated, and we should at once proceed to trephine for exploration of the brain. As Gorham Bacon says: "Operate at once if we wish to succeed, and first explore the mastoid antrum."¹

The area of primary disease is attacked first. The mastoid is opened and gonged out, the opening into the middle ear is enlarged, the auditory meatus and interior of mastoid are disinfected and packed with gauze, the mastoid wound is sutured, a new scalp incision is made, and then the skull is trephined at a definite point. The opening is enlarged with a rongeur, the roof of the tympanum is felt by a separator, the dura opened, and a director is inserted into the brain. As most abscesses from ear disease affect the temporo-sphenoidal lobe, the trephine is applied at Barker's point (one and a quarter inches above and behind

¹ Medical News, January 29, 1898.

the middle of the external auditory meatus). The director can be introduced in three different directions and to the depth of one and a half inches in the search for pus. It is first passed toward the external angular process of the opposite side, next toward the nostril of the opposite side, and finally toward the angle of the jaw of the opposite side (Keen). If pus is found, the operation is completed as previously suggested. If pus is not found, the dura is sutured, the scalp wound is closed, the occipital bone is trephined below the lateral sinus, and the director is carried into the cerebellum. Always look for pus in the cerebellum if there are distinct symptoms of abscess and no pus is found in the temporo-sphenoidal lobe.

Von Bergmann says that because of the difficulty of making a diagnosis between cerebral abscess and epitympanic abscess, the incision in the bone should be so planned that the surgeon can examine the roof of the tympanum. This can be accomplished through the incision at Barker's point, if the bone is cut away toward the ear by the use of the rongeur.

Some cases will die during operations for cerebral abscess; many will die after the operation; but in some few cases operation will be followed by brilliant success. The mortality among young children is particularly large, as they stand the shock of brain operations very badly. Holt¹ is so convinced of the great mortality among children that he does not urge operation unless there are definite localizing symptoms and the principal localizing symptom is hemiplegia. Many cases, after an abscess is opened and drained, are for a time greatly improved, but later become worse and die. This aggravation of the condition may be due to the development of another abscess, septic meningitis, or septic pneumonia. An operation may fail because more than one abscess existed but only one was found and drained, or because a single abscess could not be discovered. If septic pneumonia exists at the time the surgeon is called in, it will be quite useless to subject the patient to any operation, as death is inevitable. Drainage is often very unsatisfactory. The surgeon should be sure that the opening in the bone is well situated for drainage, and, if it is not, a part of its edge should be bitten away with rongeur forceps or another opening should be made on a level with the most dependent part of the abscess cavity. In order to prevent constriction of the tube, a small portion of scalp should be removed at the point where the tube is to emerge. It is generally advisable to cut out a portion of the scalp opposite the lower level of the trephine opening (Keen's custom). A rubber tube is safer than a metal tube, but may not drain as well. I prefer to use a large rubber tube. It

¹ Archives of Pediatrics, March, 1898.

is sutured to the scalp by silkworm-gut, the end projecting but slightly beyond the scalp, and dressings are so applied as not to bend it. The attendants are given directions to see that the patient passes a part of every day lying upon the affected side. As the discharge begins to markedly lessen the tube is removed, shortened a little, and returned to place (after ten or twelve days), and this procedure may be repeated several times. It is not removed entirely for two or three weeks. Suction drainage is not to be thought of, as it may destroy the surrounding brain tissue.

J. S. Brown¹ has protested against the use of the tube, saying it will not drain up hill. This is true, but what may be up hill when the patient lies on one side is down hill when he lies upon the other. Brown uses capillary drainage. I believe, however, that capillary drainage does not remove pus. A tube will drain part of the time; I do not think capillary drainage will remove the pus at all.

During the care of a case after operation, the dressings should be changed as often as they soak, and in every case at least once a day; the mastoid and ear should be irrigated with hot salt solution at each change of dressings, and the iodoform-gauze packing should be replaced. This packing does not satisfactorily remove pus; some purulent fluid escapes alongside of it, and the deeper portion of gauze becomes impregnated with it, hence the packing must be changed frequently. At each change of dressings the tube is examined to see if it is clear. If it is clear, hot salt solution is gently run into it, in small quantities at a time, from a fountain-syringe, each small portion being allowed to flow out before the next is introduced. This process is continued until the fluid flows away clear. If the tube is blocked, it is removed, washed in corrosive sublimate solution, at once returned, and irrigation is carried out as above directed.

Is *antistreptococcus serum* of any value in mastoid suppuration or in abscess of the brain? The evidence is scanty and doubtful.² Pringle has reported a case of mastoid disease in which opening of the mastoid antrum brought no relief. The temperature continued high; there were optic neuritis and engorgement of the retinal vessels. Antistreptococcus serum was given, and the patient improved and finally recovered. What part the serum played in causing recovery is very doubtful, but it is worthy of note that the optic neuritis completely passed away. It would never be justifiable to give the serum in lieu of operating; but if, after operating, a case does badly, it would be proper to administer it, recognizing that the value of the agent has not been determined and

¹ Medical Record, May 28, 1898.

² British Medical Journal, January 15, 1898.

that its administration is an experiment—an experiment which is not in itself dangerous, and which may possibly result in benefit.

INFECTIVE SINUS THROMBOSIS.

If the lateral sinus is affected by thrombosis because of middle-ear disease, it can be readily reached and treated surgically. Until recently infective sinus thrombosis was an invariably fatal condition, but many cases have been cured of late. Jansen reported twenty cases in which Von Bergmann saved the patients by surgical intervention. In some cases of mastoid empyema pus gathers about the sinus; in others a septic clot forms within the sinus, and in some this clot is propagated along the jugular bulb and vein into the neck. Sinus thrombosis is to be suspected if there is high and persistent fever occurring during an acute or chronic otitis media, the flow of pus continuing from the ear (Leutert). In most cases delirium exists, and chills may occur. If there is evidence that any other sinus is involved, or if septic pneumonia exists, operation will be of no avail. A diagnosis between sinus thrombosis and acute leptomeningitis with chronic otorrhea may sometimes be made by lumbar puncture. Grunert¹ has recently reported several cases of leptomeningitis in which lumbar puncture gave important information. Leutert's rule of action is very generally followed; he advises us to immediately expose the sinus in every case of empyema of the mastoid in which the acute stage of otitis media has passed away, but in which there is still high fever in spite of free purulent discharge from the ear. The mastoid should be opened, its interior gouged out and aseptized, and the sinus exposed. Leutert then waits for three days, and if at the end of that time the fever still exists, or a chill has occurred, he opens the sinus.

When a clot extends into the neck the internal jugular should be tied below the clot, Mr. Horsley having been the first to suggest this. Some surgeons always tie the jugular before opening the sinus. Grunert² reported three cases in which he ligated the jugular before he tamponed the sinus. Some open the sinus first, and do not tie the jugular if the lower end of the sinus bleeds.

Gorham Bacon³ has recently argued, with force, that it is unnecessary to ligate an internal jugular in which a clot has formed if it is possible to cause blood to flow from each end of the sinus. We believe that it is unnecessary to tie the jugular if blood flows from the lower end of the sinus.

Münchener med. Wochenschrift, December 14, 1897.

² Ibid.

³ Medical News, January 29, 1898.

When the sinus has been opened, if blood flows from both ends, hemorrhage is arrested by tampons of iodoform gauze. If blood does not flow from the upper end, a small scoop is introduced into the sinus and is slowly carried up to break up the clot and cause blood to flow. If blood does not flow from the lower end the internal jugular vein should be tied below the clot, the vein should be divided above the ligature, the clot should be removed to as great an extent as is possible by the scoop and by irrigation with salt solution, the other end of the divided vein should be tied and the wound in the neck sutured.

It is useless to operate if the other sinuses are involved, as well as the lateral, or if there be edema of the lungs or septic pneumonia.

THE SURGICAL TREATMENT OF MENINGITIS.

The advisability of operating for acute meningitis is very much in doubt. It is agreed that operation is advisable in local suppurative conditions of the meninges, but in diffuse meningitis the question is uncertain. Most surgeons decline to interfere; some, unable to form a conclusion, await further investigation, and a few warmly advocate operation. Parkin, Horsley, Barker, Tobin, and others have operated and are quoted as favoring operation in certain cases. Maty has recently taken strong ground in favor of operation.¹

Meningitis is known to be due to bacteria (tubercle bacilli, pneumococci, streptococci, and, rarely, staphylococci). All forms of infection "other than the diplococcus intracellularis are fatal."² It might justly be argued that as meningitis is a septic disease, is almost invariably fatal, and leads to the production of toxic material in a closed cavity containing vital structures, the surgeon is justified in taking the risk of operating in the hope that by affording drainage for toxic material, and lessening cerebral pressure, he may save life. As a matter of fact, however, acute meningitis is usually a secondary infection (secondary to fracture of the skull, middle-ear disease, nasal disease, erysipelas, pneumonia, endocarditis, pericarditis, etc.), and in the majority of cases it is impossible to influence favorably the seat of primary infection. Again, if the exudate is diffused over a considerable area it is impossible to drain satisfactorily, as the fibro-purulent material is apt to lie, in part at least, in the meshes of the pia and arachnoid, and drainage of a limited area only can be obtained.

When pus can be definitely localized trephining ought to be performed; but such conditions are rare. If meningitis arises secondarily

¹ Bulletin de la Soc. Cent. méd. du Dept. du Nord, April 22, 1898.

² Councilman, Mallory, and Wright, in the American Journal of the Medical Sciences, March, 1898.

to fracture of the vault of the skull or to ear disease, operation should be performed; but in typical cases of acute meningitis, in which the exudation is at the base of the brain or is wide-spread, operation promises little or nothing. The surgeon may be justified in operating for acute tubercular meningitis; but this condition is almost never primary. In some cases lumbar puncture has been employed therapeutically, and has been thought by several observers to relieve some of the symptoms. In five cases of cerebro-spinal meningitis subjected to lumbar puncture by Raczynski,¹ the pain was lessened and the vomiting and convulsions were relieved. In every case lumbar puncture should be employed for diagnostic purposes, the turbidity of the fluid and the presence of bacteria being of great importance.

CHRONIC HYDROCEPHALUS.

Many plans have been suggested for the treatment of this condition; but no plan is satisfactory. It is necessary to bear in mind that hydrocephalus may be due to one of several conditions. It may arise before birth; it may arise soon after birth; it may be due to syphilitic basal meningitis, to chronic tubercular meningitis, and to the existence of a tumor which obstructs the venous circulation, and in many cases the cause is unknown. The most common causes, according to Bruce and Stiles,² are fibrous closure of the foramen of Magendie, adhesion of the tonsils of the cerebellum to each other and to the sides of the fourth ventricle, and the existence of cysts between the pia and arachnoid and the posterior inferior portion of the cerebellum.

If there is a possibility that syphilis is the cause we should order mercurial inunctions and iodide of potassium, and compress the head with mercurial plaster.

In other cases a great many plans have been tried, without much success; among them we may mention compression of the head with a rubber bandage or with adhesive strips; vesication of the scalp; tapping through the anterior fontanelle. Puncture through the anterior fontanelle is not dangerous, is easily performed, and considerable fluid can be withdrawn; but the benefit is only temporary. Some surgeons have tapped and injected Morton's fluid; others have incised the fontanelle and made drainage. Parkin proposed trephining the occipital bone and opening the fourth ventricle, and of his cases two out of four recovered. Others have trephined in the temporal region and drained the subarachnoid space. Others have employed lumbar puncture.

¹ Wiener klin. Rundschau, February 20, 1898.

² Scottish Medical and Surgical Journal, March, 1898.

Lumbar puncture is certainly not curative. It improves the condition for a time and is not dangerous, but it leads to no enduring benefit. These are the conclusions reached by Raczynski,¹ after operating in twenty-six cases.

Parkin's operation may be curative, and it is proper to try it. Stiles² operated upon a case by draining the fourth ventricle. Parkin trephines one inch below the superior curved line and to the right of it, and enlarges the opening downward. Stiles trephined in the middle line slightly above the foramen magnum, because he considers that we will thus gain the easiest access to the fourth ventricle, in spite of the trouble due to the thickness of bone and the necessity of ligating the sinus in the falx. In his case the tonsils of the cerebellum were adherent to each other and to the margins of the fourth ventricle, and on separating them cerebro-spinal fluid flowed away. For days there was a free flow of cerebro-spinal fluid, and the patient was much improved. Stiles advocates the performance of this operation in chronic basal meningitis, tubercular or non-tubercular.

G. A. Sutherland and W. Watson Cheyne³ believe that in chronic hydrocephalus there is a closure of a portion of the channel through which the fluid of the lateral ventricles should pass to reach the sub-arachnoid space. They believe that the proper procedure is to form an outlet for the ventricular fluid into the meningeal spaces, by making a permanent opening through the cortex into a lateral ventricle. The skull should be trephined, the dura opened, a catgut drain is forced through the cortex into the ventricle, the dura is sutured over the drain, and the scalp is sutured. Sutherland and Cheyne advise operation on the opposite side at the same time or later, because the foramen of Monro may be obstructed. Sutherland and Cheyne employed this method in two cases and the distention disappeared.

BULLETS IN THE BRAIN.

When the x-rays were first studied it was not thought that it would be possible to locate by their aid bullets within the skull, because of the belief that bone was impermeable by the rays, but further study with better apparatus has shown us that bone is only relatively opaque to the new rays, and it is quite possible to obtain a skiagraph of a foreign body within the cranium. All penetrating gunshot wounds of the skull should be operated upon,⁴ and before operating the bullet should be located by the

¹ Wiener klin. Rundschau, February 20, 1898.

² Bruce and Stiles, in *Scottish Medical and Surgical Journal*, March, 1898.

³ *British Medical Journal*, October 15, 1898.

⁴ Senn. *Journal of the American Medical Association*, July 9, 1898.

x-rays if it is possible to use them. The bullet, however, should not be sought for and extracted if in an inaccessible region, and in such a case operation is performed simply to permit of disinfection and afford drainage. The search for the bullet may cause great or fatal damage. In fact, Von Bergmann fears that the ability to locate the bullet may lead sometimes to meddlesome surgery, and he is so convinced that many deaths are due to operation that he will not operate unless there are symptoms which indicate that the bullet is doing harm, and if there are no such symptoms he simply protects the wound from infection.

Von Bergmann¹ reports 32 cases in which he made no effort to remove the bullet; 8 of these cases were in a very bad condition, and soon died; 19 cases recovered and remain well; of the remaining 5 cases, 2 developed abscess of the frontal lobe, were operated upon, but died; 2 developed suppurative meningitis and died; 1 has not been heard from. Some of the patients who recovered are perfectly well; some have attacks of unconsciousness, local palsy, or spasm. Von Bergmann admits that in some of the cases it is possible that the bullet did not enter the brain. At the present time he always examines with the x-rays. In one case he saw the bullet in the white matter of the occipital lobe, in another case in the internal capsule; but in neither case did he attempt to remove it.

If we believe a bullet is aseptic we should follow the advice of this distinguished German surgeon.

If we believe that a bullet wound may be an infected wound and, at least, will probably require drainage, we should follow the advice of Semm.

If a bullet has been carried for months or years and is apparently producing no harm, no attempt should be made to remove it; but if it is producing harm it should be removed, if removal is possible.

Braatz² has reported a case in which, after two years, he located a bullet with the x-rays and removed it. The bullet lay near the foramen rotundum and the patient recovered. Péan has discussed the method of locating the bullet by the x-rays.³

OSTEOPLASTIC CRANIECTOMY.

Many methods have been employed by surgeons to effect an entry into the cranial cavity. For many years the trephine has been used. This instrument tires and makes tremulous the hand of the surgeon. It removes but a small disk of bone, and if a larger opening is required

¹ Berlin. klin. Wochenschrift, May 2, 1898. ² Centralblatt für Chir., 1898, No. 1.

³ Bull. de l'Académie de Méd. de Paris, December 7, 1897.

the trephine must be applied again, or bone must be cut away with a Hey's saw, or, what is the better plan, bitten away with rongeur forceps. The osteoplastic method, or temporary resection of the skull, is extensively employed. An omega-shaped incision is made through the scalp down to the bone, a trap-door is cut in the bone, the bone flap attached to the scalp is raised, and the cerebral operation is proceeded with. This operation enables us to obtain an extensive exposure of the brain. After the completion of the necessary intracranial manipulations the flap is restored to place.

Many operators fashion the bone flap with a chisel and a mallet. The bone is cut along the margin of the skin flap, the dura is exposed, and the narrow base of the bone flap is broken through by prying the flap up or by a stroke with the chisel. It is difficult to cut a correctly outlined groove by the chisel alone. Wagner cuts a furrow into the bone with a circular-saw at the margin of the skin incision, and deepens the groove with the chisel.¹

An objection to the use of the chisel is that it takes away considerable bone, and when the flap is restored it may not fit neatly and may even rest in part upon the dura. Another objection is the jar and shock occasioned by the repeated taps of the mallet.

The bone flap may be cut by a circular-saw, the motive power being the surgical engine, which is run by hand or by electricity. This method is rapid, and when it is used neat flaps can be formed. To use it well and safely, however, requires much training, and training of a sort which surgeons rarely have. The dentist would probably use this instrument better than the surgeon. An unskilled operator might do great damage, as the saw could slip and pass through the skull before he was aware of it.

A new method of obtaining access to the brain is the use of the Gigli saw. A Gigli saw consists of steel wire roughened in a spiral manner and with a loop at each end. Two or more openings are made by means of a small trephine; the dura is separated from the skull between the two openings; a piece of silk is passed from opening to opening by the use of a probe, the saw is attached to the silk and thus drawn through the opening.² Gigli³ introduces into each opening a curved grooved sound, and then passes a strip of whalebone from opening to opening. The whalebone passes easily between the bone and dura, and when it has passed the saw is tied to it, and as the whalebone is withdrawn it pulls the saw in place. Handles are fastened to the saw, and the bridge between the two openings is sawn just as if a chain-saw were being used.

¹ Zuckerkandl's *Atlas of Operative Surgery*. English edition, 1898.

² Keen. *Philadelphia Medical Journal*, January 1, 1898.

³ *Centralblatt für Chirurgie*, 1898, No. 16.

Obalinski maps out the bone flap by making seven openings with the trephine. Keen makes four openings. Gigli himself makes but four perforations in the skull.¹ The more openings made, the narrower is each bridge of bone, and the less apt is the saw to break. Buchanan considers 5 cm. to be a convenient distance between the openings.² The bone is sawn through between each pair of openings, except at the base of the bone flap, at which point it is sawn through in part, and then fractured by forcing out the bone flap. In sawing a thick skull the instrument may be worn out before completion of the operation. In any case a saw which has been used "curls up and is useless."³

In performing the operation of osteoplastic resection of the skull, Braatz drills the holes in the skull with an instrument which is like an auger, using at first a drill, and when the cranial cavity is nearly entered, a fraise⁴ like that employed by marble workers. If adhesions exist it would be well to follow the advice of Gigli: Circumscribe the area of the dural surface of the flap with a silk thread passed by means of the whalebone. A free end of silk projects from each of the lower trephine openings, and by pulling on these ends the adhesions are separated.

The use of the wire saw has great advantages, and it will, we believe, come to be frequently employed. One great advantage of employing it is that we can bevel the edge of bone, and when such a bevelled bone is restored to place it is supported by bone and does not rest upon the dura. Keen has been much impressed with this advantage, and points out that if we are obliged to cut away the bony margins and leave but 1 cm. of bevelled surface at any point, the bone flap will obtain good support.⁵

If drainage is required the trephine openings furnish a route.

J. J. Buchanan has tersely summed up the advantages of the operation with the Gigli saw:⁶ It injures the bone but little; it does not jar the brain nor injure the dura; flaps of various shapes can be cut; the bone flap when restored fits accurately; it is easy of performance, is rapid, and does not tire the surgeon; the instruments are simple, are not expensive, and are not dependent for their usefulness upon a motor.

This last statement of Buchanan's will impress particularly the many of us who have had motors get out of order when most needed. It is a sound rule in surgery to use as few and as simple instruments as possible. Codivilla has recently suggested an instrument for the performance of osteoplastic resection of the skull which does not appear to us

¹ *Centralblatt für Chir.*, 1898, No. 16.

² *Medical Record*, June 4, 1898.

³ Keen. *Philadelphia Medical Journal*, January 1, 1898.

⁴ *Centralblatt für Chir.*, January 22, 1898.

⁵ *Ibid.*

⁶ *Ibid.*

to be simple or uncomplicated, although he states that by its use a bone flap can be cut easily and rapidly. This surgeon drives a screw into the bone at the centre of the area which is to be fashioned into a flap. This screw carries a movable arm of metal which can carry a knife for the cutting of the scalp and osteotomes for division of the bone.¹

In operations for traumatism we are not always able to select some favorite mode of operation. As Tiffany puts it,² operation is imperatively necessary, the patient's actual condition is unknown, there has been no preparatory treatment, the area to be operated upon is often already infected, anatomical landmarks are often obliterated, and the skull must be opened as circumstances allow or dictate. In operations for pathological conditions careful preparations are made, and the plan of operation is determined on and is carried out along reasonably settled lines.

Tiffany says the breaking down of an osteoplastic flap will be much facilitated by cutting across the base with sharp forceps, and he cautions us, in these operations, to see that the scalp is not loosened from the bone flap. Tiffany prefers to make his bone flap by the use of the chisel and mallet, in spite of the objection that such a method jars the brain. Keen considers the objections to the use of the mallet to be largely hypothetical.³

It is needless to replace an osteoplastic flap in the temporal region, because the dense temporal fascia will prevent sinking in of the soft parts.⁴

OPERATIONS FOR TRIGEMINAL NEURALGIA.

If medical treatment to cure neuralgia of the fifth nerve fails, the patient becomes insistent for aid and some operation must be performed, because in most of these cases life with the pain becomes unendurable. Before concluding, however, that medical treatment is futile, we should be sure that massive doses of strychnine have been given after the method of Dana. In a recent case of violent tic, in which we had determined to perform resection of the Gasserian ganglion, the strychnine treatment was employed by my friend, Dr. Charles S. Potts, with the result that the pain ceased completely. It is impossible to affirm that the cure will be permanent, but the effect has been so positive in this case that in future I will always give the plan a trial before operating, and we should not feel sure that medical treatment was useless until

¹ *Centralblatt für Chir.*, 1898, No. 16.

² *The Technique of Intracranial Surgery*. Medical Record, June 4, 1898.

³ *Philadelphia Medical Journal*, January 1, 1898.

⁴ Tiffany, in *Medical Record*, June 4, 1898.

strychnine has been used as Dana directs. In every case have the teeth examined by a dentist and the eyes by an ophthalmologist.

Many operations have been devised for neuralgia. The earlier operations which were employed attacked the peripheral portions of the nerves, but year by year the attack has been made nearer to the centre, until now in some cases the nerves and their ganglion are removed by intracranial operation. Removal of the ganglion is a difficult and hazardous operation, and is only to be undertaken by a surgeon of extensive operative experience and after careful thought.

If all the branches of the fifth are involved, the indication is strong that the ganglion is involved, and it should be removed.

If but one branch is involved a peripheral operation should be performed first. Such operations cure some cases and give relief in most cases for a longer or shorter time. Because of the facts that relief, at least, will be given by a peripheral operation, and operation on the ganglion is so dangerous, we should offer the patient a chance with the trivial operation before advising the grave one. Keen and Spiller advocate this course.¹ Spiller believes that the ganglion is affected after the nerve trunks, the diseased process in the ganglion being in all probability secondary. Keen maintains that before removing the ganglion we should perform as many peripheral operations as possible, and remove the ganglion only when driven to it. We may be forced to remove the ganglion at first because when we see the case all of the branches are affected, or we may be driven to remove it by the failure of peripheral operations.

What peripheral operations are to be considered? Neurotomy and neurectasy possess only a very temporary power for good, and it is useless to employ them. Neurectomy should be performed, the nerve being attacked as near the centre as possible, and a considerable portion should be cut away.

In supra-orbital neuralgia it is rarely necessary to operate, as such cases can usually be controlled to a great degree by medical means alone.²

If operation becomes necessary neurectomy is performed. The incision is made below the level of the eyebrow and parallel with the margin of the orbit, the orbital contents are separated from the bone, the nerve is found on the orbital roof, and its branches are sought for and torn away separately.³

For infra-orbital neuralgia the removal of the nerve from below the foramen is of but temporary benefit. We can do the operation of Langenbeck and Horsley, invading the orbit, breaking into the canal

¹ Memorial volume of the Anniversary of Prof. Durante. Keen and Spiller on "Re-section of Gasserian Ganglion."

² Rose and Carless. *A Manual of Surgery*, 1898.

³ Zuckerkandl. *An Atlas of Operative Surgery*, 1898.

and removing the nerve; but in this operation the surgeon is apt to break into the antrum, and if this accident occurs infection will almost certainly follow. Another plan is that of Carnochan. If Carnochan's method is decided upon, the antral wall is trephined, the posterior wall is trephined with a smaller trephine, and the sphenomaxillary fossa, which contains Meckel's ganglion, is thus exposed. The nerve canal is broken into in the antral roof, the nerve is cut under the foramen rotundum and removed. The Lossen-Braun operation consists in temporary resection of the malar bone, division of the nerve at the foramen rotundum, and removal of the nerve, and is the most satisfactory plan for removing the superior maxillary division.

If neuralgia affects the inferior maxillary division of the fifth nerve, we can remove the buccinator, the lingual or the inferior dental branch. The buccinator nerve can be reached by the method of Zuckerkandl, which consists of an incision through the skin and other soft parts, retraction of Steno's duct, and exposure of the tendinous insertion of the temporal muscle, the nerve being found by the inner edge of the tendon. The inferior dental nerve may be attacked by exposing the mental nerve, grasping it and rolling it out around forceps; but the good result of such a procedure is brief and slight. The nerve may be exposed before it enters the canal, the incision being made from without or from within the mouth. The nerve can be reached within the canal by removing a portion of the ascending ramus of the jaw from over the canal by the use of the chisel or trephine. Krönlein devised what is known as the retrolucal method for reaching the nerve at the base of the skull. Mikulicz reaches the nerve trunk by temporary resection of the inferior maxillary bone. A method should be selected which enables us to cut the nerve soon after its emergence from the cranium.

If both the second and third divisions are affected with neuralgia, these nerves can be exposed at the base of the skull by an operation which was also devised by Krönlein. In this operation the zygomatic arch is sawn through in two places, and the separated portion is, with the masseter muscle, reflected downward, the coronoid process of the inferior maxillary bone is sawn through and with the tendon of the temporal muscle is lifted upward. The superior maxillary nerve can be reached at its point of exit from the foramen rotundum, and the inferior maxillary nerve as it emerges from the foramen ovale.

Ligation of the Common Carotid Artery. It has been suggested that ligation of this vessel should be performed in some cases of trigeminal neuralgia, and some surgeons believe that it may do good. Ricketts¹ claims that ligation of the carotid is more safe and certain

¹ Journal of the American Medical Association, October 16, 1897.

than are intracranial operations. He maintains that neuralgia is due either to hyperemia or anemia. When hyperemia is the cause, he says that this operation cures, doing so by lessening hyperemia, not by producing any alteration in the structure of the ganglion.

Intracranial Operations. If medical treatment or peripheral operations fail to cure a case of trigeminal neuralgia, an intracranial operation must be performed. If all the branches are involved, a peripheral operation is useless and an intracranial operation should be performed as soon as we are convinced that medical treatment is useless. The intracranial operation consists in the removal of the Gasserian ganglion. Such a procedure is very formidable. It is difficult, may be very bloody, and is decidedly dangerous, and should be attempted only by those who have performed many surgical operations and are confident in their ability to manage hemorrhage. The surgeon works through a small opening, and the area of operation is encompassed by important structures (cavernous sinus, middle meningeal artery, internal carotid artery, and ocular nerves).

The mortality from the operation is large, and may be due to shock, hemorrhage, or septic meningitis. Tiffany estimates the mortality as 22.2 per cent., and Keen agrees with this estimate.¹ Keen has operated upon eleven cases with three deaths.

After removal of the ganglion the patient may be cured; but in four reported cases the pain has returned. In two of Keen's cases the pain returned, but he calls attention to the fact that these were his two first operations, and in one of these cases, in which the fragments were examined microscopically, no ganglion cells or nerve fibres were discovered. Keen says that he thinks the cases were imperfectly done, and recurrence of pain in these cases is no argument against the removal of the ganglion.² Destruction of the ganglion may be followed by certain ill consequences, the greatest risk being damage to the eye. The cornea may ulcerate and the eyeball may be destroyed. There is always anesthesia of the conjunctiva and cornea, and, as a result of this condition and the absence of lachrymal secretion, the patient does not wink and foreign bodies tend to accumulate in and to irritate the eye, which organ may be lost by destructive inflammation. The changes in the eye are not trophic, but are due to injury and sepsis, which are especially dangerous to an area of anesthesia. Among other possible ill results, are sinking in of the flap when bone has been removed, deafness partial or complete, necrosis of bone, paralysis of the eye muscles and paralysis of the muscles of mastication of one side. Keen says

¹ Keen and Spiller. *The American Journal of the Medical Sciences*, November, 1898.

² *Ibid.*

we can master the tendency to eye trouble, and all other disadvantages "are very slight as compared with the immense relief from the horrible pain."¹

If an intracranial operation is decided upon we can decide between Rose's method, Doyen's temporo-sphenoidal method, Horsley's method, and the Hartley-Krause method. In all intracranial operations the surgeon should be provided with a forehead electric light.

ROSE'S OPERATION. An incision is begun just below the external angular process, is carried to just above the zygoma, carried back at this level until posterior to the line of the condyle, and then down in front of the ear to the angle of the jaw. The flap of soft parts is separated and retracted, the zygoma is sawed and is turned down with the masseter muscle, the coronoid process is sawed and raised with the tendon of the temporal muscle, the internal maxillary artery is ligated, the foramen ovale is found near the base of the posterior margin of the external pterygoid plate, a probe is passed through the foramen ovale and into the ganglion, the skull is trephined external to the foramen, and the opening is enlarged and the ganglion is scraped away.

The objections to this method are decided. It gives the surgeon very little room to work in, and if hemorrhage occurs it is hard to control; the Eustachian tube is apt to be injured, and injury to this tube may cause infection or fatal meningitis, and, as the ganglion must be scraped away, it is doubtful if it can be completely removed.

A. E. Halstead² says: "The dangers of this operation are so great and the disadvantages so apparent that it has been generally abandoned by surgeons."

DOYEN'S METHOD. Doyen makes a sickle-shaped flap, the curve being in the temporo-sphenoidal region and the handle being between the external angular process and the auditory meatus and passing 15 mm. below the zygomatic arch. He resects and retracts the zygomatic arch, saws the condyle, exposes the temporal fossa; he finds the lingual and inferior dental nerves, grasps them with forceps, cuts them, and ligates the internal maxillary artery; he finds the inferior maxillary nerve, traces it up to the foramen ovale, trephines on the line of the temporo-sphenoidal suture, and enlarges the opening into the foramen ovale with rongeur forceps. By drawing on the superior maxillary nerve the ganglion is brought within reach. He cuts the superior maxillary nerve at the round foramen and the first division at the sphenoidal fissure.

As the internal maxillary is tied before entering the skull, there is no danger of bleeding from the middle meningeal; the ganglion is

¹ Keen and Spiller. *The American Journal of the Medical Sciences*, November, 1898.

² *Chicago Medical Recorder*, December, 1897.

reached with ease, and even the ophthalmic division is brought into view. The operation seems to offer points of great advantage, but I have had no personal experience with it.

HORSLEY'S METHOD. He makes a horseshoe incision, exposes the squamous portion of the temporal bone, opens the dura, lifts the temporo-sphenoidal lobe with a retractor; the fifth nerve is found, is followed back to the ganglion, and that structure is removed with its sensory root.

Horsley's method is very unsafe: it exposes the brain extensively and this delicate organ may be injured, and there is considerable risk of venous bleeding.

THE HARTLEY-KRAUSE METHOD. This method is the favorite plan with most surgeons. A horseshoe-shaped flap is made, the base of the flap being the zygoma. An osteoplastic flap is cut by chisels, the Gigli saw, or the surgical engine, and the base of the flap is broken by prying the bone outward. The dura is separated from the middle fossa. The third division is found at the oval foramen, and the second division at the round foramen. These nerves show distinctly, being marked by dural folds, and each nerve is cut through above its foramen. The nerves are traced up to the ganglion, the ganglion is exposed, grasped with forceps and twisted out, and during the twisting the sensory root will usually be brought out. In this operation there may be hemorrhage from the middle meningeal artery or from the veins on the floor of the skull. In some cases where hemorrhage is furious it is necessary to insert packing and postpone the completion of the operation.

The Hartley-Krause method I believe to be the best operation at our command. In view of the eye trouble which is so apt to ensue, Tiffany has suggested that only the outer two-thirds of the ganglion should be removed with the second and third divisions of the fifth nerve; but, as Keen points out, the ganglion is not divided into thirds "physically or physiologically," but all the ganglion cells are connected somewhat with all the three divisions. To leave the inner third of a diseased ganglion is to leave diseased cells which may cause the return of pain.¹

The eye can be saved from serious danger if, at the time of operation, the lids are stitched together, an opening being left at each canthus for drainage. In four or five days the stitches are cut and the eye is covered with a Buller's shield, which is worn from ten days to a month (Keen's plan).

Tiffany suggests that the motor root be saved, in order to prevent paralysis of the muscles of mastication, but it does not seem surgically possible to save the motor root.

¹ Keen and Spiller. *The American Journal of the Medical Sciences*, November, 1898.

TRAUMATIC INTRACRANIAL ANEURISM.

It is a well-known fact that a blow upon the head precedes some intracranial aneurisms, especially of the internal carotid. Gowers says we find the history of a blow in 6 per cent. of cases. In intracranial aneurism an audible murmur is very rare, and yet, if a murmur does not exist, the diagnosis from tumor is difficult or impossible.

A case of great interest has been recorded by Hinde.¹ The patient, who was thirty-six years of age, had a fall and struck the back of his head, and some months later the eyes became congested and the right eye bulged. When examined, eighteen months after the accident, there was exophthalmos of the right eye and the conjunctival, subconjunctival, and retinal veins were tortuous and greatly enlarged, but these vessels did not pulsate. The pupillary reflex was diminished, there was lessened power of abduction of the right eye, and the retinal arteries of the right eye were normal in size and appearance. The retinal veins were enlarged and tortuous, but did not pulsate. Around the arteries and veins there was perivasculitis, but the choroid and retina were normal. The sensibility of the right cornea was lessened. The patient, a few days after his injury, noticed a noise in his head, and this noise had ever since persisted. By listening with a stethoscope a bruit was audible in the right temporal region and slightly audible in the left temporal region. Stooping increased the bruit, but pressure on the right internal carotid artery completely arrested it.

In Hinde's case the symptoms were remarkably definite. The distinct bruit is a notable fact, as bruit has rarely been detected in recorded cases. The pressure symptoms were significant of the situation of the growth: the cavernous sinus, the ophthalmic division of the fifth nerve and also the sixth nerve were being pressed upon. Hinde's diagnosis was aneurism of the internal carotid artery following fracture of the base of the skull, the aneurism being situated at the side of the body of the sphenoid bone. The common carotid artery was tied and the case was cured.

The custom has been in such cases, when a definite diagnosis could be made, to tie the common carotid. In my opinion the ligation of the internal carotid would be a proper procedure. It can be readily tied in the first part of its course. An intracranial aneurism of the internal carotid artery may rupture, producing symptoms of apoplexy. If, in a person known to have such an aneurism, apoplexy developed, it would be proper to tie at once either the common or the internal carotid. In an intracranial aneurism of the basilar artery, if the condition is recognized, the two vertebral arteries should be tied. The method of tying the vertebral artery has been pointed out by Alexander.

¹ Journal of the American Medical Association, December 4, 1897.

THE DISEASES OF CHILDREN.

BY ALEXANDER D. BLACKADER, M.D.

DISEASES OF THE NEW-BORN.

Asphyxia. The subject of asphyxia in the new-born is one of much interest to the general practitioner, and during the past year several suggestions for improved methods of treatment have appeared in the medical journals. Dr. Fürst¹ writes that in dealing with the livid form our first care should be to clear the air passages from all obstructing material, and then, as promptly as practicable, to stimulate the respiratory centre by means of the sudden shock of cold water, or alternate hot and cold baths. In these cases the umbilical cord should not be tied too early. In the pallid form the writer has little confidence in the use of electricity or in the blowing of air directly into the lungs. Artificial respiration is our only effective means of restoring circulation and respiration, and Schultze's method is one of the best and the most frequently employed. The author's instructions should be followed out exactly, as injuries may otherwise be inflicted upon the child. After six or eight swinging motions the infant should be dipped in a warm bath, sufficiently hot to act as a stimulus to the heart and superficial nerves. The swinging motions and the hot baths may be alternated for some time, securing about one hundred and fifty swinging motions within an hour. Lange² adds that if no attempts at respiration are made after a few swinging movements, rhythmical compression over the cardiac region should be employed at the rate of about one hundred and thirty a minute.

According to Winter, no child should be considered dead until it has been subjected to this rhythmical, rapid compression over the region of the heart. Should the temperature of the infant threaten to fall, a prolonged warm bath may be given, and during its administration artificial respiration, according to Sylvester's method, should be resorted to, and compressing movements should be made over the heart. These measures should be employed either synchronously or alternately, according to the amount of assistance available. Schultze's method is fatiguing to the physician and may be alarming to the parent. It is contraindicated in all cases where fracture of any bone has occurred. Hogner³ recommends

¹ *Der Kinderarzt*, 1898, vol. ix. p. 27.

² *Ibid.*, vol. ix. p. 30.

³ *Medical Times and Register*, January 29, 1898.

the following method as effective, easy of application, and not distressing for the parents or friends to witness: The operator should be seated on a high chair with knees together, the thighs forming an inclined plane, and vessels of hot and cold water should be within easy reach. On the operator's left hand, with palm up and wrist lying between his knees, the child is laid on its back with the head supported by the extended left fingers, and its body so inclined that fluids tend to escape through the nostrils; its arms should be outstretched and allowed to hang downward and backward, thus bringing the pectorals into a state of tension and raising the thorax into the position of inspiration. The operator places his right hand, with extended fingers, on the child's chest and abdomen, the tip of the middle finger resting on the throat, the index finger and ring finger on the subclavicular spaces, and the thumb and little finger in the armpits. Pressure with the right hand produces expiration; on removal of the pressure an inspiratory movement is induced by the above-described position of the child. The alternate pressure and non-pressure of the right hand leads to an artificial respiration of any required depth and rapidity. Between the respiratory movements the heart may be stimulated by compression over the præcordial region, made by the right finger, middle finger, and ring finger, and, if deemed advisable, the child may be dipped into either lukewarm or hot water, and the chest sprinkled with cold water. This method very closely resembles that of Dew, where inspiration is effected more by the abdominal muscles than by the pectorals, and expiration by flexing the extremities upon the body.

Subcutaneous injections containing a few drops of spirit of wine or brandy, with one drop of tincture of belladonna, are strongly recommended by Bedford Brown,¹ who emphasizes, also, the importance of maintaining the temperature of the child, and considers that efforts at resuscitation should be continued so long as the temperature in the rectum of the infant does not fall many degrees below normal.

Dr. Stringer² makes a suggestion which may occasionally be of service. He noticed, in a case of abortion where fœtus, membranes, and placenta were all delivered by the same effort, that the fetal circulation was carried on for several hours after birth by aëration of the blood through the medium of the placenta exposed to the atmospheric air. It occurred to the author that this procedure might be utilized in cases of asphyxia in newly born infants, and in several subsequent cases he proved that this simple plan may sometimes be preferable to all others. The placenta should be spread out with the maternal surface clear of all clots, so that it may have free access of air. Its heat, so far as practi-

¹ *Therapeutic Gazette*, June, 1897.

² *Texas Courier-Record of Medicine*, June, 1898.

cable, must be maintained. So long as the circulation is maintained through the cord there is no need to fear for the life of the child, and as soon as respiration occurs circulation is diverted from the placenta to the lungs, and pulsation in the cord ceases in a few seconds. Cases may occur in which this plan may be combined with efforts to produce artificial respiration. Stringer refers, also, to the advantage which may possibly be gained in this way by prompt delivery of the placenta in cases of placenta prævia.

The after-treatment of these resuscitated infants requires care. They should be laid on their right side, with the head thrown well back and lowered, and a careful observation of them should be made at least every hour. If any signs of returning asphyxia be noticed, irritation should be at once applied to the skin and a hot bath should be administered. Lange considers a hot bath every five or six hours the best prophylactic measure against inhalation pneumonia or extensive atelectasis.

Hemorrhage.—The causes of hemorrhage in the new-born are still extremely obscure. Doubtless the great delicacy of the vessels, combined with the important changes which take place in the general circulation, may predispose to its occurrence; but in the majority of cases in which hemorrhages occur there appears to be some constitutional condition, either in the blood or in the bloodvessels, acting as an exciting cause. Davist regards these hemorrhagic conditions of the new-born as of an infectious origin, allied to other cases which do not come to the point of actual hemorrhage, but in which the new-born child gradually develops green stools, prostration, convulsions, coma, and death. In connection with Dr. Bevan, pathologist, he made an investigation, at the Maternity Department of Jefferson Medical College Hospital, of the conditions predisposing to this infection. In a number of cases a careful examination was made of the blood, breast-milk, and placenta of the mother, and of the blood and feces of the infant. At the time the observations were made, so far as was known, no acute infective process was present in the hospital. It was found that no correspondence existed between the number of cells or the percentage of hæmoglobin in the blood of a mother and that of her infant. Examination of the placenta for micro-organisms in all cases gave uniformly negative results. An examination of the breast-milk showed that in 57 per cent. of the cases it was sterile before the child had nursed, while in the remaining 43 per cent. the ordinary pyogenic bacteria were present. In 11 per cent. of the cases micro-organisms were present in the feces of the child before it had nursed. In one of these the mother was in good condition, but in the child's feces, passed before nursing, the micrococcus pyogenes albus was

¹ Archives of Pediatrics, September, 1897.

obtained in pure culture. In this infant the stools became green in a few days, the temperature rose, hemorrhages occurred from the mucous surfaces, and death resulted. From these observations Davis infers that in the milk of the mother, and sometimes in the intestinal canal before nursing, organisms may be present which are capable of setting up infection in the infantile intestinal tract, with resulting toxæmia. So far as treatment is concerned, he considers that thorough lavage of the intestines with sterile saline solution gives the best promise of success.

Garber¹ reports a case of severe gastro-intestinal hemorrhage occurring in an apparently healthy female child on the second night after birth. In this case, owing to improper feeding, there was considerable gastric disturbance; recovery took place under the administration of large enemata of normal saline solution.

Although a toxæmia arising from gastro-intestinal infection may be present in some cases, such a theory will by no means explain all the instances in which this condition arises. Dr. Parry,² discussing the etiology of gastro-intestinal hemorrhage, enumerates the following as possible causes: There may be hemorrhage into the bowels, caused by pressure at birth, just as there may be hemorrhage into other viscera, such as the brain or lung; such hemorrhage may even be sufficient to cause intestinal obstruction; there may be acute fatty degeneration of the new-born, a disease which Buhl described in 1861; a condition of hæmophilia may be present; but in this case a family history may generally be traced. Hæmatemesis and mælena may be due to a fissure in the mother's nipple, to some lesion of the child's mouth or nose, or there may be a distinct ulceration of the duodenum or stomach as described by Goodhart and others. Intussusception may be thought of, but in such case a tumor could in all probability be felt through the abdominal wall. The late Lewis Smith quoted Vogel as stating that congestion of the pelvic veins might arise from the cessation of the circulation after tying of the cord. Fischer³ reports a case of mælena neonatorum which he attributes to a congestive hyperæmia of the stomach or intestines, due to a late division of the cord after strong uterine contractions had taken place. Lastly, there may be true hæmatemesis or mælena neonatorum, of which the pathology is still obscure. The mortality in this disorder is high. In 1890 Dussier reported a mortality of 55 per cent.; in 1893 Ott reported, out of eighty-seven cases, a mortality of 51.6 per cent.; in thirty-four cases falling under Hermory's notice the mortality was 51.4 per cent., whilst Minot, of Boston, places it as high as 86 per cent. In estimating the rate of mortality, however, the number of infants who merely die from the effects must not alone be considered, for many who

¹ *Pediatrics*, October 15, 1897.

² *Lancet*, July 16, 1898.

³ *Münchener medicinische Wochenschrift*, 1897, vol. lxi., p. 504.

do not succumb at once never recover completely from the after effects.¹ Hermory² says that when the hemorrhage is so insignificant as not to affect the general condition of the child, treatment should be of an expectant character. In graver cases, however, three indications for treatment are present. The cutaneous circulation should be stimulated by friction with alcohol, by warm baths, or, better still, by the use of an incubator in which the temperature may be kept constant. An effort should also be made to check hemorrhage by the use of mild astringents, such as gallic or tannic acid, or by the use of one of the vaso-constrictors, such as ergotin. Many physicians, however, question the value of any medicines administered internally. Undoubtedly there is danger in those cases where the hemorrhage takes place from the walls of the stomach, lest we increase by irritation the vascularity of its mucous membrane. A third indication is to sustain the vital powers. Suckling at the breast is, in most instances, contraindicated, and feeding should be effected by the spoon. In those cases where the mother's milk appears unsuitable or indigestible, carefully sterilized milk should be allowed, sufficiently diluted, and in small quantities only at a time. Finally, should collapse threaten or grave anemia result, subcutaneous injections of saline solution must be resorted to. After the bleeding has been finally arrested the infant will need careful supervision for some time, and any constitutional diathesis, if present, will require treatment.

In this connection we note a case, recorded by Holt,³ of *pemphigus neonatorum* with general infection by staphylococci, which occurred in an infant nine days old. Numerous bullae were seen over the shoulders, buttocks, and thighs, ranging from one-quarter to one inch in diameter, but there were none upon the chest, back, feet, or hands. A severe purulent ophthalmia was also present; the navel was normal. Examination of the pus from the eye showed a large quantity of pus organisms, but no gonococci. Examinations from the pus of the bullae showed a pure culture of the staphylococcus pyogenes aureus. No history of syphilis was obtainable. The infant rapidly grew worse, and died from exhaustion on the third day after admission into the hospital. Holt believes in the syphilitic origin of a number of these cases; but in a certain percentage the condition, in his opinion, is one of acute general infection and the bullous eruption is only one of its manifestations.

Ophthalmia Neonatorum. Although many communications on the subject of ophthalmia neonatorum have appeared in the medical press during the past twelve months, but little has been added to our knowl-

¹ Editorial, Pediatrics, August 1, 1897.

² Revue Internationale de Médecine et de Chirurgie, vol. vii. No. 22.

³ New York Medical Journal, 1898, vol. xlvii. No. 6.

edge. Pflüger,¹ in a carefully written article, condemns the use of sublimate solution, believing that it frequently injures the cornea, and recommends, for thoroughly cleansing the conjunctival sac, a saturated solution of boric acid. This may, in some cases, be diluted with an equal quantity of normal saline solution. Nitrate of silver he regards as superior to all the organic salts of silver which have recently been recommended, and it should be used in solutions varying in strength from 0.2 to 2 per cent. Its employment should not be commenced until the initial swelling has to some extent subsided, and has been replaced by the suppurative stage. Cold, in the form of ice compresses, is indicated only in the initial stage; as soon as this stage has passed and membrane shows itself on the conjunctiva cold acts unfavorably and should be replaced by warm compresses steeped in the boric-acid solution. The eyes should be cleansed thoroughly every half-hour or hour, and, to avoid agglutination of the lids, vaseline should be applied. Chartres² has made careful bacteriological examinations of the pus from twenty-six cases of ophthalmia neonatorum, and has found the disorder due to many forms of pathogenic microbes. In 36 per cent. gonococci existed alone; in 12 per cent., Loeffler's bacilli; in 12 per cent., micrococci; in 8 per cent., streptococci, and in 8 per cent. gonococci with streptococci were found. The most unfavorable cases were those in which streptococci existed either alone or associated with gonococci or with the bacillus of Loeffler. When the gonococcus was found alone the prognosis was generally good. He considers, therefore, that a bacteriological examination of the discharge at an early stage of the disease is of importance in the prognosis.

Malformations. Congenital malformations, as a rule, are more matters of curiosity than of practical interest. A case of *congenital diaphragmatic hernia*, reported by Booker,³ is of unusual interest, however, as the abnormal condition was associated with recurrent attacks simulating Henoch's asthma dyspepticum. The infant was apparently well developed and at birth weighed eight and one-half pounds; there was no indication of cyanosis, and its condition remained satisfactory up to the ninth day, when it was attacked with symptoms resembling those of severe colic. Indications of imperfect digestion persisted from that time, and when about five weeks old the infant again had an attack of severe colicky pain associated with vomiting and dyspnea, the respirations numbering from 60 to 80 in the minute. Percussion resonance over the chest was accentuated, and the tympanitic sound of the abdomen was transmitted high into the thorax; vesicular breathing could be heard over the whole of the chest, but was more feeble than normal; the abdomen was

¹ Correspondenzblatt für Schweiz. Aerzte, 1897, vol. xxviii. p. 357.

² Archives Cliniques de Bordeaux, 1896, No. 12.

³ Archives of Pediatrics, September, 1897, p. 649.

soft, not distended. The more urgent symptoms passed off in about twenty-four hours, but the breathing continued labored, and exacerbations recurred at intervals of a few days, many of which were so severe that the child appeared, for the time, almost moribund. As careful and repeated examinations of the chest revealed nothing distinctly abnormal, the labored and rapid breathing during these attacks was regarded as of the nature of Henoch's asthma dyspepticum. Osler, who saw the case in consultation, concurred in this view. Various remedies were tried for the purpose of relieving the paroxysms, but none appeared of much value. Gradually, however, the paroxysms became more moderate, and the child appeared to be thriving, when, at the age of eleven weeks, death suddenly occurred during a paroxysm which appeared to be of only moderate severity. At the post-mortem examination a deficiency was found on the left side of the diaphragm through which almost all of the small intestines, together with the transverse colon and the greater part of the omentum, had passed into the left pleural cavity, occupying the whole of it with the exception of the small space taken up by the compressed left lung. The right lung showed some compensatory emphysema.

Congenital diaphragmatic hernia is of comparatively rare occurrence, and is, in most instances, the result of an arrest of development. Its recognition during life is extremely difficult. Out of 245 cases analyzed by Leichtenstern¹ the diagnosis was made with certainty in only four cases, in all of which the patients were adults. Owing to its rarity the condition is apt to be overlooked in considering the possibilities in diagnosis.

Sudden and Unexplained Death. Instances of sudden and unexplained death are occasionally reported as occurring during infancy. Bertholl² states that in the majority of cases this unfortunate accident is due to a swelling or hyperplasia of the thymus gland. He quotes Grawitz, who reports two cases of previously healthy children, one aged six and the other eight months, in whom the only pathological condition found post mortem was an enlargement of the thymus gland. This, apparently, had caused sudden death through pressure on the trachea and bronchi. In young children this gland is liable to many pathological changes which may occasion a marked increase in its size. Of peculiar interest is the condition of simple hypertrophy, which frequently attacks healthy and even robust children, and which may run a latent course. In these cases a sudden twist or bending of the neck may occasion a fatal asphyxia. Occasionally the hypertrophy can be made out with some certainty during life. Biedert diagnosticated this condition as the cause

¹ Berliner klin. Wochenschrift, 1874.

² Archiv für Kinderheilkunde, 1898, vol. xxiv, p. 136.

of a severe and fatal dyspnoea, from the dulness on percussion over the sternum, with forward bulging.

Siegel¹ reports the history of a child two and a half years old, who developed asthmatic attacks associated with a more or less permanent dyspnoea. Tracheotomy was performed, but gave only slight relief. When the patient had been under observation two months the mediastinal space was opened and the thymus was seen to protrude with each inspiration. It was carefully pulled forward as far as possible and attached to the fascia of the anterior mediastinum. The breathing at once became quiet in spite of the removal of the tube. The child improved rapidly, and in six weeks left the hospital cured.

Recently Escherich has stated that in infancy enlargement of this gland may play an important rôle in producing sudden death during an attack of laryngismus stridulus. This accident, he considers, is particularly liable to occur in lymphatic children with pale, delicate skins and enlargement of lymphatic glands in neck and axilla. Another possible cause of sudden death by asphyxia, pointed out by Beneke, may arise in rachitic children in whom some disproportion exists between the weight of the head and the muscular strength of the neck. In such, any sudden retraction of the infant's head may produce a stenosis of the trachea and prevent the entrance of air. If not promptly remedied death may ensue.

INFANT FEEDING.

In a recent paper on the subject of infant feeding,² Holt enumerates the various forms of infant feeding which are practised to-day, as follows: The exclusive use of commercial foods or of canned condensed milk; the use of fresh cow's milk, with the addition of various foods or substances which are believed to modify the milk so as to increase its digestibility, particularly as regards casein; and, lastly, the use of only the elements of cow's milk with or without some form of sterilization. Infant feeding, he writes, is a problem in nutrition, and the success of any method must be judged by its ultimate results. Not infrequently satisfactory results are obtained at the outset from the use of many commercial foods, and such results are especially noticeable in those cases where an infant has previously been fed on cow's milk not properly adapted by modification to its digestion. The prolonged and exclusive use of such a diet, however, reveals in time, by the appearance of rickets or scurvy, the lack of some of the essential elements of food required by the growing infant. For this reason a prolonged use of these foods

¹ Jahrbuch für Kinderheilkunde, Band xliv. Hefte 3 and 4.

² Archives of Pediatrics, November, 1897.

has not met the approval of the most advanced portion of the profession. Especially is this the case with those foods which are complete in themselves and simply require the addition of water. Those foods which require in their preparation the addition of fresh cow's milk are not open to so serious objection. Some of these latter consist largely of soluble carbohydrates which may supply the deficiency of this element in cow's milk, especially if the milk be diluted. With our present knowledge, however, these foods must be regarded as possessing very little, if any, power to modify the casein of cow's milk or to increase its digestibility. Those commercial foods which contain a large amount of unchanged starch are successful in an inverse proportion to the amount of them employed. Prepared as a thin gruel, and added in due proportion to fresh milk, they may serve as diluents, but used in large quantities they are liable to give rise to fermentative disturbances in the intestines. The addition of digestive ferments to milk, for the purpose of assisting the infant's stomach by a partial predigestion of the casein, is at times extremely useful, but it should not be continued indefinitely, or the stomach will not develop the capacity for doing the work. As a routine method of feeding, such peptonized food is greatly inferior to a proper modification of the elements of cow's milk. At the present day all pediatricists agree that no artificially fed infant can safely be kept for a prolonged period upon a diet which does not contain fresh cow's milk. As temporary substitutes the commercial foods may at times be admissible, but their use should go no further.

Cow's milk, however, differs from breast milk, the infant's proper food, in the percentage of its elementary constituents and in the presence of numerous bacteria, sometimes pathogenic, and always disturbing to the infant's digestion. Moreover, the proteids of cow's milk are distinctly more indigestible than are the proteids of breast milk. These differences present distinct obstacles to its satisfactory employment in infant feeding.

To overcome some of these objections, Dr. Jacobi¹ and the late Dr. Lewis Smith for many years advocated a partial modification of it, which involved the addition of some thin cereal gruel and of an amount of sugar of milk sufficient to supply the deficiency arising from such dilution. On this subject Dr. Jacobi writes: "There ought to be no more than one per cent. of casein in an infant's food. Dilution with water alone may in many instances appear to be harmless, for some children thrive on it. More, however, only appear to do so. . . . A better way to dilute cow's milk, and at the same time to render its casein less liable to coagulate in large lumps, is by the addition of a decoction of one of the cereals. Cereals containing a small percentage of starch are to be pre-

¹ *Therapeutics of Infancy and Childhood*, second edition.

ferred, such as barley and oatmeal. The newly born ought to have its sterilized milk (sugared and salted) mixed with four or five times the quantity of barley water; the infant of six months may have equal parts of both." With the great majority of pediatricists, however, this, in some ways an excellent, but somewhat crude plan, has given place to the very accurate modification of cow's milk, first proposed by Rotch, in which the different elements are varied separately according to the age and digestive powers of the particular infant under observation.

As it is generally the casein in the cow's milk which occasions our difficulties in arranging for the feeding of an infant, it is usual to start with a milk the composition of which resembles breast milk except in its percentage of proteids. These, at the outset, should be kept low, and only very gradually increased as the infant's power of digesting them is developed. In carrying out this variation it is found desirable to have some way of expressing definitely the proportions used, and none has proved so satisfactory as to speak and write, and, as Rotch says, to think, in percentages. The average composition of mother's milk is generally regarded as: Fat, 3 to 4; sugar, 6 to 7; proteids, 1 to 2; ash, 0.20 to 0.25; water, 87 to 88. In preparing, therefore, a modification of cow's milk to resemble this we may use the following percentages at the beginning: Fat, 3; sugar, 6; proteids, 0.50 to 1. The amount of ash in the cow's milk employed may be regarded as sufficient when increased by the slight amount of alkali necessary to neutralize its acidity. In employing this method we should note that no special percentage will be found to be always suitable for a special age. Careful analyses of many specimens of mother's milk show considerable variations in all the ingredients, especially in the fat and in the proteids, and in arranging our percentages, if we would succeed, we must study carefully the digestive powers of the particular infant and endeavor to discover any existing idiosyncrasy. To this end we should not simply be satisfied that digestion is performed easily, but the general nutrition should be carefully watched, and, as far as practicable, estimated by having the weight of the infant regularly taken. Rotch¹ says that in cases of difficult proteid digestion he obtains the best success when he reduces the proteids first to a minimum, and then gradually, as the proteid digestion becomes stronger from not being overtaxed, he increases their percentage until the amount necessary for nutrition is attained. Thus, beginning with a proteid percentage of 0.25, he increases it very gradually up to 1 and 1.50, and only allows the full percentage contained in cow's milk after the infant has passed its twelfth month. In the diarrhoeal cases met with during summer he has found that low percentages of all the elements of

¹ Medical News, April 3, 1897.

the milk afford the best results; his average percentages being: Fat, 1.50 to 2.50; sugar, 4.50 to 5.50; proteids, 0.25 to 0.67.

Speaking of the feeding of premature infants, he says:¹ "In this early period of development, not only are the lungs and heart immature and in need of a carefully modified air, but the gastro-enteric tract is also undeveloped in its size and functions; it needs smaller quantities of food and shorter intervals of feeding than at the stage of development met with at birth. Its functions are essentially weak, and many a premature infant has died from being put to the breast of its own mother, for the human mamma has not been able to modify its milk constituents into low percentages. In this class of cases careful modification of cow's milk by employing low percentages may give the premature infant a better chance for life than human breast milk. Any one who has followed a premature infant from the day of its birth up to the time of weaning, giving it nothing but carefully combined percentage feeding, seeing it digest and thrive first on 0.50 of fat, 4 of sugar, 0.25 of proteids; then on 1 of fat, 5 of sugar, 0.50 of proteids; then 1.50 of fat, 5.50 or 6 of sugar, and 0.75 of proteids; then on 3 of fat, 6.50 of sugar, 1 of proteids; then on 3.50 of fat, 6.50 of sugar, 1.50 of proteids; then on 4 of fat, 7 of sugar, and 2 of proteids in the sixth month, cannot help feeling that we are approaching, at least, the time when an exact system of dealing with nutrition is to be hoped for."

In the preparation of the various combinations of percentages to suit the varying necessities of the infant's digestion, it is unquestionably a great convenience to have the milk laboratories recently established in many of the larger cities in America. We may also add that such combinations can be made with greater exactness in such establishments than by any method of home modification, owing to the difficulty in obtaining cream and milk of unvarying percentage. Rotch considers the "top-milk process" very uncertain. Nevertheless, in the opinion and experience of many physicians, the home modification of milk can in many cases be carried out with sufficient exactness, provided that the physician is able to give exact instructions as to the details of the process. Various formulæ have been proposed by several writers to assist the prescriber in ordering the necessary modifications, but all of them are not only more or less difficult of application, but the complicated rules easily slip the memory. Westcott² has proposed several formulæ, all excellent in the results obtained; but, in striving for minute exactness, he has to some extent lost the advantage of simplicity. Coit³ advocates the use of the decimal system in calculating the quantities to be used in the modification of milk, urging its simplicity and accuracy. Until physicians and the public generally

¹ Medical News, April 3, 1897.

² Archives of Pediatrics, January, 1898.

³ Ibid., June, 1898, p. 454.

become more accustomed to the calculation of quantities by the metric system, this method must be regarded as unpractical. Bauer¹ recommends a series of simple and practical rules based on the understanding that good cow's milk contains on the average 4 per cent. of fat and 4 per cent. of proteids, thus regarding cream as simply a superfatted milk, containing practically the same amount of proteids as milk itself. So long as the cream is fresh and clean we may use either a 12 per cent. cream, obtained by allowing milk to stand over ice in a tall vessel for six hours and removing the upper fifth; a 16 per cent. cream, obtained in the ordinary way by skimming, or a 20 per cent. cream, obtained by the separator. For convenience in explanation, the 16 per cent. gravity cream is supposed to be employed in the following rules, but only a very slight change is necessary if using cream of another percentage. Having decided upon the exact percentage deemed most suitable for the case, and the number of ounces required for the day's feeding, the physician will then proceed to estimate the amount of cream to be used in the mixture by the following rule: Subtract the proteid percentage from the fat percentage and multiply the remainder by the total number of ounces of the mixture, divided by twelve. This gives the cream in ounces. For the estimation of the milk, multiply the quantity of the mixture by the proteid percentage, and divide by four. This gives total milk and cream; subtract from this the amount of cream, and the remainder will, of course, be the amount of milk required. It is hardly necessary to estimate the water, as it is self-evident that the entire mixture, less the milk and cream, will be water. To obtain the amount of dry milk-sugar, multiply the difference between the sugar and proteid percentages by the quantity of mixture, and divide by 100.

FORMULÆ FOR DETERMINING THE AMOUNTS OF CREAM, MILK, WATER, AND DRY MILK-SUGAR REQUIRED TO MAKE ANY DESIRED QUANTITY OF MIXTURE TO CONTAIN GIVEN PERCENTAGES.

Given: Quantity desired (in ounces) = Q.
 Desired percentage of fat = F.
 Desired percentage of sugar = S.
 Desired percentage of proteids = P.

To find (in ounces):

$$\text{Cream (16 per cent.)} = \frac{Q}{12} \times (F - P).$$

$$\text{Milk} \dots\dots\dots = \frac{Q \times P}{4} - C.$$

$$\text{Water} \dots\dots\dots = Q - (C + M).$$

$$\text{Dry milk-sugar} \dots\dots = \frac{(S - P) \times Q}{100}.$$

If 20 per cent. centrifugal cream is used, the denominator of the cream formula will be 16 instead of 12. If 12 per cent. cream is used, it will be 8 instead of 12.

¹ New York Medical Journal, March 12, 1898.

Examples.—Suppose we want forty ounces of a mixture to contain 4 per cent. of fat, 7 per cent. of sugar, and 2 per cent. of proteids:

$$\text{Cream} = \frac{40}{12} \times 2 = 6\frac{2}{3} \text{ ounces.}$$

$$\text{Milk} = \frac{40 \times 2}{4} = 6\frac{2}{3} = 13\frac{1}{3} \text{ ounces.}$$

$$\text{Water} = 40 - 20 = 20 \text{ ounces.}$$

$$\text{Sugar} = \frac{5 \times 40}{100} = 2 \text{ ounces.}$$

The directions to the nurse would then be to dissolve two ounces of milk sugar in twenty ounces of water, add $13\frac{1}{3}$ ounces of milk and $6\frac{2}{3}$ ounces of cream (skimmed), and divide into as many bottles as desired. The question of adding lime-water or other alkali, and the question of pasteurizing or sterilizing, would have to be considered, but do not come within the scope of this article.

As another example, suppose we want twenty-four ounces to contain 4 per cent. of fat, 6 per cent. of sugar, and 1.5 per cent. of proteids:

$$\text{Cream} = \frac{24}{12} \times 2.5 = 5 \text{ ounces.}$$

$$\text{Milk} = \frac{24 \times 1.5}{4} = 5 = 4 \text{ ounces.}$$

$$\text{Water} = 24 - 9 = 15 \text{ ounces.}$$

It should, of course, be remembered that a very high fat with a very low proteid percentage cannot be made with 12 per cent., 16 per cent., or possibly even with a 20 per cent. cream. It can easily be seen that with a 16 per cent. cream it is only possible to make the fat percentage four times the proteid; with 20 per cent. cream, five times, etc. A great advantage of these equations is the ease with which odd amounts of mixture can be calculated. The question of how to obtain a good, fresh cream of definite percentage is an important one. At present cream is apt to be anything the dealer can get the customer to accept as cream, whether the fat is 4 per cent. or 40 per cent.¹ It is usually so laden with spore-bearing germs that pasteurization is, to a great extent, ineffectual. The "top-milk" method has the advantage of ensuring freshness of cream, and the emulsion is probably more perfect than in the cream at present obtained by means of the centrifugal machine. Cow's milk, it is to be remembered, has a distinctly acid reaction, while mother's milk is almost invariably slightly alkaline. It is, therefore, always advisable to add some alkali (either lime-water or sodium bicarbonate) sufficient to neutralize acidity and secure a slight degree of alkalinity in our milk mixtures.

The importance of obtaining a good, clean milk for infant feeding has been emphasized by all writers both in Europe and America. All cow's milk is more or less contaminated by the presence of micro-organisms varying in numbers from a few thousand to four or five millions in each cubic centimetre; all of them to some extent affect the digestibility of the

¹ Huddleston. Archives of Pediatrics, January, 1898.

milk; many forms are distinctly pathogenic. To avoid them the most scrupulous cleanliness is necessary in the production and handling of the milk, and the interval of time elapsing from the milk leaving the cow till it reaches the infant must be as short as practicable. The question at what temperature milk should be sterilized to secure effective destruction of these micro-organisms was discussed at length in a paper read by Freeman before the American Pediatric Society.¹ He maintained that there was ample evidence to show that sterilization at 155° F. for thirty minutes was sufficient. A series of questions were sent to all the leading pediatricists in the country, and the replies showed a remarkable unanimity of opinion to the effect that low temperatures, 155° to 167°, are, in general, effective for sterilization, and that if it were possible to obtain it perfectly clean, raw milk would be the best for the infant. Many physicians consider that the sterilization of milk at 212° F. has several disadvantages. This opinion, however, is not shared by all. Holt and Booker both claim that the mere sterilization of milk does not influence its digestibility to any extent, and that it has no tendency to induce scurvy. Koplik regards pasteurization at a temperature of 167° F. insufficient for the complete destruction of the bacteria, and cites a number of cases in which infants developed diarrheas while on pasteurized milk, but quickly recovered when sterilized milk was substituted. The question must, therefore, still be regarded as *sub judice*, and can only be decided in time by clinical experience. My own, in Montreal, is distinctly in favor of pasteurization at a low temperature; in my opinion sterilization at the temperature of 212° F. for many children distinctly impairs the digestibility of the milk. Milks, however, that are not clean, or have been long delayed in transportation and contain bacteria in large numbers, may require the higher temperature. Such milks, however, are not suitable for employment in infant feeding. During the warmer months of the year all milks employed in infant feeding should be either pasteurized or sterilized, except when used direct from the cow.

Many efforts have been made during the past few years to have milk of a higher grade of purity supplied under special conditions in some of the larger cities in America. Coit² has inaugurated a plan which has been successfully operated in New Jersey during the last two or three years. A commission of medical men who have the support of physicians in the district undertakes the oversight and control of the general hygienic conditions present on the milk farm, the mode of feeding and milking the cows, the character of the herd itself, and the manner in which such milk should be placed upon the market. Well-known experts are employed to periodically inspect the dairy and to make bacteriologi-

¹ Archives of Pediatrics, July, 1898.

² Ibid., November, 1897.

ical examinations of the milk. Such milk is placed upon the market duly certified, and, to reimburse the dairyman for his additional outlay, a higher market value is placed upon it than upon milk obtained and delivered in the old-fashioned, careless way. This effort has proved so successful in New Jersey that in several large cities efforts are now being made for similar oversight and certification. In New York, through the liberality of a few men, pure milk suitably modified and pasteurized is delivered in sterilized bottles, and can be obtained by the poor through the medium of the several city dispensaries.

In Germany, during the last few years, Gaertner's milk modification, or *fettmilch*, is much employed. Briefly stated, milk suitable for infant feeding is obtained by this method as follows: Into the drum of a large centrifuge a mixture of milk and sterile water at a temperature of 30° to 35° C. is allowed to run. Care is taken that the milk used is obtained in the most cleanly manner, from healthy cows, properly fed. The drum of the centrifuge is made to revolve at a certain speed. In the course of the revolutions the fat, being in suspension, collects in the centre of the drum, whereas the sugar, casein, and salts remain uniformly distributed. Two tubes which carry off the milk enter the drum, one near the centre and one at the periphery. By arranging how near to the centre the inner tube opens, and the speed at which the drum revolves, milk containing fat in various percentages may be drawn off. As ordinarily set, the milk drawn off near the centre has the same amount of fat as mother's milk, and is only deficient in sugar. Its composition, which is fairly constant, is: Fat, 3; sugar, 2.5; proteids, 1.76; and ash, 0.35. By adding a certain proportion of lactose we get a milk nearer in composition to mother's milk than has heretofore been attained by any simple method. The thin milk drawn off by the tube at the periphery is almost wanting in cream. By this process any dirt present in the milk and many of the bacteria are thrown off toward the periphery, and the central milk is thus freed from them. Gaertner claims also, as a special advantage of his method, that the cream is not first separated from the milk, but remains in more perfect emulsion. Thus prepared, the *fettmilch* looks like ordinary good milk with a thick cream layer. Its taste is agreeable to the majority of children. Like all commercial milk, it requires sterilization. At Gratz, in the original dairy, this is done in bottles, each bottle containing the amount necessary for one feeding. After sterilization the milk is at once cooled in running water, and then kept cold until it leaves the dairy. Escherich has laid down the following rules for the amount and the frequency with which this food may be given: During each twenty-four hours children of two weeks require 16 ounces in nine meals; from two to four weeks, 25 ounces in eight meals; from four to eight weeks, 33 ounces in eight meals; children of

three to four months, 42 ounces in eight meals; and of five to six months, 50 ounces in seven meals.

In an interesting paper on the composition of human milk by Professor Carter, of Birmingham, and Mr. Richmond,¹ the authors detail the methods employed in, and the results obtained from, a careful analysis of ninety-four samples of human milk. All were taken within the puerperal month. The analysis shows that wide variations in the several ingredients of breast milk are met with. The greatest variation was observed in the fat; in one case its percentage reached 8.82, and in another fell as low as 0.47 per cent.; proteids vary from 4.05 per cent. to 1.02 per cent.; the proportion of sugar varies the least, its highest percentage rising to 8.89, and the lowest being 4.38. The average composition of mother's milk, according to their analysis, is stated to be: Water, 88.10; fat, 3.08; sugar, 6.75; proteids, 1.87, and ash, 0.25. Some of the variations in the fat were, they think, due to the position of the mother when the milk was withdrawn; if in a prone position the cream is drawn off first. They noted little difference whether the cream was drawn off before or after suckling; in general, it was higher after suckling. They think that the sugar in human milk is not pure lactose, for it differs in its specific rotatory power and does not taste as sweet. They say that there is some evidence to show that two sugars are present. Referring to the clinical aspect of these variations, Professor Carter says that there were five deaths among forty-two children, and in each of the fatal cases the percentage of proteids in the mother's milk was high, ranging from 2.05 to 4 per cent. In all the cases excepting three, the milk disagreed with the infant when the proteids exceeded 2.5 per cent. Variation in the percentage of the other ingredients seemed to be much more easily borne. On this subject Adriance² sums up a report upon the chemical examination of two hundred specimens of human breast milk as follows: 1. Excessive fats or proteids may cause gastro-intestinal symptoms in the nursing infant. 2. Excessive fats may be reduced by diminishing the nitrogenous elements in the mother's diet. 3. Excessive proteids may be reduced by a proper amount of exercise. 4. Excessive proteids are especially apt to cause gastro-intestinal symptoms during the colostrum period. 5. The proteids, being higher during the colostrum period of premature confinement, present dangers to the untimely born infant. 6. Deterioration in human milk is marked by a reduction in the proteids and total solids, or in the proteids alone. 7. This deterioration takes place normally during the later months of lactation, and, unless proper additions are made to the infant's diet, is accompanied by

¹ British Medical Journal, January 22, 1898.

² Archives of Pediatrics, vol. xiv. No. 2.

a loss of weight, or the child's gain is below the normal standard. 8. When this deterioration occurs earlier it may be the forerunner of the cessation of lactation, but well-directed treatment may improve the condition of the milk.

DISEASES OF THE ALIMENTARY TRACT.

Pyloric Hypertrophy. A rare condition during the first few weeks of life, and undoubtedly of congenital origin, is *stenosis of the pylorus, with hypertrophy*, leading to a condition to which the name of gastric spasm has been applied. Thomson¹ describes two cases of this very unusual condition. The first child died at the age of twenty-eight days, and the second at the age of nine and a half weeks. In both these cases the only morbid condition found after death was a very marked hypertrophy of the muscular coat of the pylorus and of the pyloric end of the stomach, associated with distinct stenosis of the orifice. In a second paper,² Thomson discusses the main clinical and anatomical facts of the cases so far published. He states that there was nothing of special interest to be noted in the family histories. In some cases the symptoms commenced a few days after birth; in others, the infant remained apparently well for from one to five weeks. The first notable symptom was vomiting, which in the beginning occurred at comparatively long intervals, but rapidly increased in frequency and soon followed every attempt to swallow fluid, even the smallest amount being violently rejected at once. The tongue, as a rule, was clean; the vomited matter consisted simply of the fluids swallowed, mixed with a moderate amount of mucus. The vomit was never bile-stained. In other cases the vomiting was not so urgent, but two or three times a day a large amount of fluid, the accumulation of several meals, was pumped up, the vomiting continuing until the stomach was empty. This process was regularly repeated. The stools became very small in amount, and the bowels were very constipated. Nutrition failed more or less rapidly, and death took place, in the cases recorded, at periods varying from three weeks to six months.

In reference to the etiology and pathology of this peculiar condition, Thomson considers that it seems more in accordance with the facts and history of these cases to suppose that the essential fault giving rise to the muscular hypertrophy *in utero*, as well as to the vomiting after birth, lies not in the stomach contents, but in its nerves. In his opinion, some fault in the nervous apparatus, due probably to a delayed or imperfect development, leads to ill-coördinated and, therefore, antagonistic,

¹ Edinburgh Hospital Reports, 1896, vol. iv. pp. 116, 123.

² Scottish Medical and Surgical Journal, 1897, vol. i. No. 6.

action between the muscles of the stomach and pylorus. In accordance with this theory he termed the condition "congenital gastric spasm." During the past year several additional cases have been reported. Meltzer, of New York, in an interesting paper read before the Association of American Physicians, opposes this theory of Thomson's, and prefers to regard the congenital hypertrophy of the pylorus as a primary condition of the nature of an embryological malformation, and not as secondary to an ill-explained over-action, which, while it might account for the muscular hypertrophy, fails to explain the hyperplasia of mucous and submucous tissues. The life-history of the stomach in these cases may, he thinks, be divided into three periods: the first is one of simple insufficiency, in which the stomach is only able to empty part of its contents through the stenosed pylorus; the second period is that of attempted compensation, with increasing dilatation and hypertrophy, characterized by repeated and violent vomiting; the third period is the stage of atony and permanent gastrectasy. In the first stage, he says, we shall rarely be consulted; but if a child a few days after birth becomes extremely restless and drinks greedily, the possibility of a congenital stenosis of the pylorus should be remembered. Later on, with the development of a state in which violent vomiting comes on directly after food is taken, where the rejected matter shows an absence of bile, and where indications of dilatation of the stomach with hypertrophy can be detected, a congenital stenosis may be diagnosticated.

TREATMENT. In considering treatment we should remember that instances are on record in which patients have lived to advanced age notwithstanding the existence of a very narrow pylorus. Meltzer quotes a case, reported by Landerer, of a man who died at the age of forty-five years of marasmus, and in whom the lumen of the pylorus measured only 2 mm. The stenosis in this case was apparently congenital.

Treatment in the early stages should be directed chiefly to careful regulation of the amount and frequency of the feeding. Several times a day the stomach should be emptied and washed out. Vomiting is to be regarded as salutary, and no efforts should be made to check it. The rectum may be cautiously utilized for additional nutrition. When symptoms of failing nutrition appear, surgical measures should be considered, and typical pylorectomy is, according to Dr. Meltzer, the ideal operation. It should be performed early, for, if the condition of gastrectasy becomes permanently established, success can scarcely be looked for.

Dilatation of the Stomach. The frequency with which dilatation of the stomach occurs in poorly nourished infants has been emphasized in an article by Comby.¹ Artificially fed children, especially, are apt to

¹ *La Presse Médicale*, June 26, 1897.

suffer from this condition, which manifests itself during life by slow digestion and frequently by symptoms of auto-intoxication. As regard treatment, frequent irrigation of the stomach is demanded, and, at the same time, the dietary should be carefully arranged, lessening the quantity given at each meal, and securing by careful modification its digestibility. Efforts should be made to improve general nutrition. Small doses of tincture of *nux vomica* may in some cases be administered with advantage.

Ulceration of the Stomach. True ulceration of the stomach occurring during infancy or early childhood is very rarely met with. Soltan Fenwick¹ has collected nineteen cases in which such ulceration occurred in children under fourteen years of age. In twelve the symptoms were acute, and in five the disease began immediately after birth. Cade² reports a case, with perforation, in an infant of two months, which ended fatally. While it is not uncommon at the autopsies of young infants to find shallow ulcers and ecchymoses in the gastric mucous membrane, an ulceration presenting the characteristic appearance of the simple round or perforating ulcer of the adult is very infrequent. In Cade's case the infant, two months old, was admitted to the crèche with a history of having suffered from diarrhoea and vomiting for a month. The stools showed no trace of blood. Within a few days a furuncular eruption appeared over the back, the child's condition became rapidly serious, and death took place on the following day. From the autopsy and microscopical examination, Cade concludes that this case was one of simple round perforating ulcer, as both tuberculosis and syphilis could be excluded. He states that twenty cases are reported in which gastric ulcer was found in patients ranging in age from a few hours to thirteen years. After discussing these cases, he draws the following conclusions: Round ulcer of the stomach, presenting the same anatomical characteristics as those met with in adults, is found in young children and in the new-born, but is very rare; it may occur on any portion of the gastric mucous membrane, but is more frequently seen in the duodenum; peritonitis, from perforation, and hemorrhage constitute the principal complications.

Dr. Martha Wollstein, writing on the subject of *ulcerative gastritis*, states that in 390 detailed autopsies on children, inflammatory lesions in the stomach were noted 11 times. Of these 11 cases, 3 were tubercular and occurred in infants suffering from a severe general form of the disease; in 2 the lesions were pseudo-membranous; in 6 of the other cases the ulcers were multiple, varying from three to seventy or more in number. They were round, penetrating in depth through the mucous coat, rarely into the muscular coat. No relation existed between the severity

¹ International Clinics, Series vii. vol. ii. p. 165.

² Revue Mensuelle des Maladies de l'Enfance, February, 1898.

of the gastric lesions and the condition of the remainder of the digestive tract. In two of the cases a bacteriological examination revealed the presence, in numbers, of the bacillus pyocyaneus. According to Charlin's experiments, lesions varying from local congestion to ulceration with hemorrhage were found in rabbits and guinea-pigs inoculated with cultures of this bacillus. In all reported cases of pyocyanic infection a general tendency to a hemorrhagic condition is present. It is quite possible, as Dr. Wollstein suggests, that this bacillus may in some instances be the effective agent in melena neonatorum, and, perhaps, in the purpura of late life.

Cyclic Vomiting. An interesting condition, as to the exact etiology of which we are still uncertain, is cyclic vomiting. Among the first to call attention to this disorder was Gee, who, under the title of "Fitful or Recurrent Vomiting,"¹ described the history of several cases which were undoubtedly instances of this disorder. More recently Snow² and Holt have both reported cases. Whitney³ has given us the history of a very typical case in which a boy of eight and one-half years, described as well nourished, but with a distinctly neurotic family history, had recurring attacks of uncontrollable vomiting. The vomiting occurred at strikingly uniform intervals of three months almost to a day, with one exception, in which the interval was only two months. These attacks all resembled one another in presenting no ascertainable immediate cause and in their having a prodromal period, varying from twelve to twenty-four hours, followed by a stage of uncontrollable vomiting lasting from eighteen to thirty-six hours. This condition was followed by rapid recovery under practically no medication. The prostration present during the attack was unusually severe. In the intervals between the attacks digestion appeared to be normal, but under medical advice the diet had been regulated with the greatest care. The attacks were not attended by headache nor by abdominal pain. This description of the symptoms holds true for the majority of the cases reported. With regard to the pathology of this disorder, the conclusion would seem to be unavoidable that we have to deal with a gastric neurosis allied to migraine. In some cases migrainous attacks have appeared to alternate with those of a purely gastric disorder. Rachford states that he has observed a gradual transition, with advancing youth, from early cyclic vomiting to a definite migraine. In the case described by Holt "careful examination of the urine showed that the quantity of uric acid eliminated during the attack was greatly diminished." Rachford⁴ refers the etiology of many of these cases to a condition of lithemia. Crozer Griffith, in a discussion at a

¹ St. Bartholomew's Hospital Reports, 1882.

² Archives of Pediatrics, 1893.

³ Ibid., November, 1898.

⁴ Ibid., September, 1897.

meeting of the Philadelphia Pediatric Society (April, 1898), referred many disorders in children associated with gastro-enteric symptoms to a condition of auto-intoxication. In the milder forms of this complaint there may be only a coated tongue, constipation, and vomiting of moderate degree, the whole attack being over in a day or two; cyclic vomiting he regarded as one of its most severe forms. He thinks that we err if we attribute this condition to something that the child has just eaten. It would appear, rather, to be due to an accumulation of some poisonous material in the system; perhaps the product of a chronic indigestion. Although the normal relation between the excretions of urea and uric acid is distinctly altered in these attacks, we must remember that after all the retention of uric acid is, perhaps, a symptom only and not a cause. The whole subject is still very imperfectly understood. It is also possible that these attacks may be of the nature of a pure neuræsis, and not dependent upon any poison.

TREATMENT. In this disorder medicine at the time of the attacks appears to be of no avail. The chief indication seems to be to prevent their recurrence, and on general principles as much exercise in the open air as is practicable should be secured. Over-study and too long hours at school are to be forbidden; the dietary must be regulated, allowing a minimum of the more stimulating meats and a maximum of fresh and stewed fruits, and the more simple farinacea. During the intervals between the attacks the antilithic course recommended by Rachford may be employed.

The Diarrhœas of Infancy. On the subject of the gastro-intestinal disorders of infancy many communications have appeared in the medical literature of the past year, but no important additions to our knowledge have been made. The chief exciting cause recognized at the present day by all physicians is the introduction or development within the intestinal canal of one or of several forms of pathogenic bacteria, which, chiefly by the action of their products, induce more or less irritation of the intestinal mucous membrane and produce the symptoms of a toxæmia. Lesage¹ writes that in a small class of cases gastro-enteric disturbance may be entirely functional in character, and due to the presence, in the infant's food, of irritating substances not the result of fermentation. In another class the disturbance may be the result of fermentation in the intestinal canal of indigestible but sterile food; in this class any constitutional intoxication that may arise is due to the abnormal development of bacteria previously existing in the canal. In by far the largest number of cases, however, disturbance in the alimentary tract is due to the introduction of bacteria from without, and the most frequent vehicle for this introduction is unquestionably cow's milk.

¹ *Traité des Maladies de l'Enfance*, Grancher, 1897, tome deuxième, p. 500.

Little reference is necessary, in such a brief review of the subject as this purports to be, to the well-recognized predisposing causes which influence the development and course of these bacterial infections; for example, the age of the infant, the season of the year, the method of feeding, etc. Seibert pointed out that whenever the minimum temperature of the atmosphere, for twenty-four hours, reaches the neighborhood of 60° F., infantile diarrhoeas assume the character of a wide-spread epidemic. An attempt has also recently been made to connect the epidemic character of the disease with the temperature of the soil. Priestley,¹ after careful investigation, has corroborated the statement of Ballard, that the heavy mortality from this class of disorders does not commence until the thermometer, four feet below the surface, reaches a temperature of 56° F. That there is a relation of cause and effect between the two facts has in no way been proved. Too often, with infants, the food substituted for breast milk is more or less difficult of digestion, defective in composition, and liable to be supplied too frequently or in too large amounts, in this way setting up indigestion, undoubtedly the most important predisposing cause of infantile diarrhoea. Quick and complete digestion is the great safeguard with which nature opposes the undue development of micro-organisms in the intestinal tract. Indigestion, by permitting fermental changes in the stomach and upper part of the small intestines, furnishes the conditions under which any pathogenic bacteria, either just introduced by means of contaminated food or present in the canal, but previously hindered in their development, may flourish and evolve their poisonous toxins. All conditions which by depressing the vitality of the infant impair its digestive power may to that extent be considered as predisposing to the occurrence of gastro-enteric disease.

According to Baginsky,² quoted by Allyn,³ the infantile organism may be infected by these bacteria and suffer in various ways. Micro-organisms not distinctly pathogenic in themselves may, under abnormal conditions, so increase in number that they become intestinal irritants either in themselves or through their products. The bacteria which give rise to acid by-products, such as lactic, acetic, or butyric acids, belong to this class. These micro-organisms are for the most part introduced in the infant's food, in which their action may have already commenced. The infant may also, in some few instances, be infected through its surroundings, air, water, clothing, etc., by micro-organisms which thrive at the temperature of the body and develop poisons in the intestine even from germ-free food. Such micro-organisms develop in greater abundance if the food is only imperfectly digested and leaves a residue assimilable with

¹ Report for Borough of Leicester, 1894.

² *Berliner klinische Wochenschrift*, 1894, No. 43.

³ *University Medical Magazine*, 1895, vii. 740.

difficulty. Micro-organisms distinctly pathogenic in character may be introduced with the milk and develop with great rapidity at the temperature of the body. Such micro-organisms may be poisonous either in themselves or through their products. These products have a distinct chemical composition, and their specific action is in no way bound up with the life of the microbe. From the products of some bacterial forms found in the intestinal contents of infants suffering from diarrhoea, Vaughan isolated proteid substances which, when injected in minute quantities under the skin in animals, produced toxic symptoms manifested by vomiting, purging, and elevation of temperature.

Booker, whose paper¹ has almost a classical value, states that in infantile diarrhoea the conditions permitting the development of bacteria appear to differ from those present in the healthy intestine of breast-fed infants. The bacterial forms present a greater variety; forms met with only occasionally, and in small numbers in health, now become more prominent, and occasionally appear in large numbers, while the bacillus coli communis and the bacillus lactis aërogenes become more uniformly distributed throughout the intestine. No single species is met with sufficiently frequently to be regarded, in itself, as the specific excitant of diarrhoea; but among the many forms encountered several varieties of streptococci and the proteus vulgaris appear to possess a special importance. Though much discussed, the question as to whether either of the two forms (the bacillus coli communis and the bacillus lactis aërogenes) normally met with in the intestine, under the abnormal conditions met with in diarrhoea develop pathogenic properties, can scarcely be said to be definitely settled. Recent studies² of the first-named variety indicate that it may, undoubtedly, under a modified environment, suffer a distinct change in its vital functions and become altered in virulence. Lesage³ states that his investigations indicate that there is a virulent, as well as an inoffensive, form of the colon bacillus; these forms may be distinguished from one another by the effect which they individually have on the serum of a horse previously immunized by the toxin of the virulent form. The virulent form is, he states, especially likely to develop in *crèches* and in rooms crowded with children.

The anatomical lesions met with in the intestinal tract of the infant as the result of this bacterial infection are of a varied character, modified apparently according to the intensity of the irritant and the period of time during which its action has persisted. A recent English writer,⁴

¹ A Bacteriological and Anatomical Study of the Summer Diarrhoeas of Infants. Johns Hopkins Hospital Reports, vol. vi.

² Peckham. Journal Exper. Medicine, No. 5, 1897.

³ Revue de Thérapeutique, Nov. 15, 1897.

⁴ Fenwick. Disorders of Digestion in Infancy and Childhood, 1897, p. 100.

however, acknowledges that there is frequently a surprising want of relation between the post-mortem evidences of disease and the severity of the clinical phenomena, and *vice versa*—a lack of relation which thus far pathologists have not satisfactorily explained. Vaughan¹ writes: "The gravest symptoms in the most speedily fatal cases are often accompanied by the most superficial lesions; while, on the other hand, symptoms so mild that no anxiety is awakened may result from marked and extensive pathological changes. . . . It would be as unscientific to attempt a classification of the diarrhoeas of infancy founded upon pathological anatomy as it would be to designate acute, subacute, and chronic arsenical poisoning as desquamative, catarrhal, and ulcerative gastro-enteritis." In a general way, however, we may say that in the more acute cases the lesions are comparatively superficial and are in great part confined to the lower end of the ileum and to the colon. In cases running a longer course the inflammatory changes may be more pronounced. In some instances an invasion of the mucosa by bacteria takes place in areas where the epithelium is absent. The local conditions are by no means always to be taken as a measure of the general systemic disturbance, for in a proportion of cases the manifestations of an acute general infection are pronounced, and are evidenced in the liver by fatty degeneration, and sometimes necrosis of the liver cells; in the kidney by necrosis of the epithelium in the convoluted and irregular tubules, and in the lungs by a lobular pneumonia.²

In a few cases of a protracted character, distinct ulceration, which for the most part is superficial, may supervene. In others the tissues in the central part of the follicles break down and form small but deep ulcers with overhanging edges, which show a tendency to extend, chiefly into the submucous tissue. Such protracted cases very generally end fatally; in those in which such a termination is avoided, convalescence is slow. Sometimes when diarrhoea assumes a chronic form the trouble will frequently be found to be kept up by the presence of one or more of these ulcers, which with great difficulty take on a healing action.³

Various classifications have been proposed to meet the varying conditions met with as the result of this bacterial infection. Baginsky,⁴ excluding the purely functional troubles of a dyspeptic character, distinguishes two forms of infantile diarrhoea—the catarrhal, of which the type is cholera infantum, and the enteric or follicular, of which the type is dysentery; but many intermediate forms are recognized by him. At the beginning he considers the gastro-enteric disorders of infants to be only

¹ American Text-book of Diseases of Children. Second edition, 1898, p. 163.

² Booker. *Loc. cit.*

³ Holt. Diseases of Infancy and Childhood, 1897, p. 355.

⁴ Arch. f. Kinderheilkunde, Band xxii. Heft 3-6.

functional in character and to be the result of alterations in the motor and secretory functions of the canal combined with abnormal chemism. Later on changes in the mucous membrane occur which may range from catarrh to necrosis. The follicular changes are independent of the catarrhal. In cases of long standing the two may be combined, in which event ulceration is likely to occur. Booker very similarly groups the acute cases of diarrhea into three classes. In the first he places all cases of a dyspeptic and non-inflammatory character: in these the stools are lumpy and acid, and contain no leucocytes or epithelial cells; the bacteria are only those of normal healthy motions; the diarrhea is of a milder form and for the most part easily controlled; but, if neglected, it shows a tendency to take on the characters of one of the two succeeding classes. The second group is characterized by symptoms of moderate inflammation, but there is present a well-marked toxic condition of the system; the stools are numerous, of a watery or pasty consistence, and contain few if any leucocytes, but bacilli in distinctly predominating numbers, which seldom, however, exist in any one variety so greatly in excess as to exclude the influence of other forms. In the third group of cases we meet with a distinctly inflammatory diarrhea associated with symptoms of a general infection; the stools are frequent and slimy, and contain many leucocytes; streptococci are found in predominating numbers, although other forms of bacteria are also present. In the more severe cases an invasion of the tissues of the intestinal wall by the streptococci takes place, and in many instances more or less extensive ulceration of a suppurative character may be found post mortem. Of this classification Booker says that in typical instances the three forms may be easily recognized, but there are many transitional cases which do not fall into any one of the three groups, and are probably due to a more mixed infection in which no one bacterium is especially predominant. This classification of Booker's corresponds clinically with that of Holt, who, however, lays more emphasis on the anatomical post-mortem changes. To these groups we must add a fourth, comprising those cases which assume a chronic type and which are not infrequently met with as the sequelæ of one of the preceding forms. With this group, as with the others, we can draw no definite dividing line separating it sharply from the more acute cases. Holt terms those cases chronic which have persisted longer than six weeks. Some cases, however, assume the type of chronicity sooner even than this. In them the signs of active inflammation subside; the appetite partially returns; the diarrhea, though lessened, still persists, and is associated in some instances with a varying amount of ulceration of the intestinal wall, in others with a more or less atrophic condition of the intestinal glands. The progressive emaciation indicates how serious is the interference with the processes of digestion and absorption.

These somewhat indefinite groups may be tabulated as follows :

1. Functional diarrhoeas, non-inflammatory in character.
2. Inflammatory diarrhoeas, in which the symptoms of a toxic systemic infection are predominant.
3. Inflammatory diarrhoeas, in which, in addition to the systemic infection, the symptoms of an acute local inflammation have a prominent part.
4. Chronic diarrhoeas, in which the acute inflammatory symptoms have more or less subsided, but in which the stools remain abnormal both in character and frequency ; in this class emaciation is apt to supervene.

TREATMENT—In the treatment of acute intestinal disorder in its varying forms, all recent writers emphasize the importance of securing as promptly and as effectively as possible a clearing out of the intestinal tract. This is best effected by means of a promptly acting purgative, followed, if necessary, by lavage of the stomach and large intestines ; at the same time the development of bacteria is to be checked by stopping for several days the administration of all forms of milk food and permitting only sterile water, or a thin barley or rice water, which may be given freely. For the evacuation of the intestinal tract two drugs especially commend themselves on account of their promptness and of the slight amount of irritation which they induce. These are castor oil and calomel. Castor oil is undoubtedly of much value in those cases in which it can be retained by the stomach ; frequently, however, this organ is too irritable, and we must have recourse to calomel, which has the advantage of acting not only as a purgative, but also as an intestinal antiseptic.

Lesage¹ recommends that if the onset of the disorder is with high fever, a foul-smelling but not abundant diarrhoea, and a considerable amount of tympanites, sufficient calomel to act as a prompt purgative should be administered in one dose : for an infant of three months, one grain ; over three months and under one year, two grains, and over one year and under three, three grains. In cases where the fever is only moderate, where the abdomen is soft and not distended, and where the diarrhoea is copious, he prefers to use small doses of about one-fifth grain, given every one or two hours for six or twelve doses. Should vomiting persist a careful lavage of the stomach at this period of the disease will prove of much value.

A few hours after the administration of the purgative an effort should be made to wash out the colon. The infant should be placed on its back with its hips well elevated, and normal saline solution should be allowed to flow slowly into the intestines through a large-sized rubber catheter, introduced for six or eight inches. The pressure in the tube should be slight, the reservoir not being higher than one to two feet above the hips

¹ Loc. cit.

of the patient. The injection should be continued until the solution returns clear. Should there be much pyrexia the temperature of the water may be lowered eight or ten degrees after the current has been once established. Lower temperatures than this have been recommended by some physicians, but the interesting experiments of R. Coleman Kemp warn us that we may in this way produce too much depression. He more frequently noticed an undue susceptibility to the action of cold than to that of heat.¹ Moreover, cold injections stimulate peristalsis and add to pain. If done carefully, the pulse, after the injection, should evidence more strength, and the blood-pressure should be raised, not lowered. Lesage² recommends that after the lavage a compress, wrung out of cool, tepid, or warm water, should be applied over the abdomen and covered with oiled silk and a flannel binder. This soothes and assuages pain. This washing out of the intestines may be repeated every eight or twelve hours for the first two or three days; afterwards less frequently. Many physicians consider the addition of a mild antiseptic to the cleansing solution to be of advantage. Stein³ recommends for this purpose a solution of salicylic acid of the strength of 1 to 2 parts per 1000, or of boric acid 5 to 10 parts per 1000, or of creolin $\frac{1}{10}$ to $\frac{1}{15}$ parts per 1000, or of tannin 20 to 50 parts per 1000. As the amount of fluid retained in the intestines after the tube is withdrawn must always be an unknown quantity, the possibility of more or less systemic depression arising from absorption of the antiseptic, in my opinion, more than counterbalances any slight advantage gained by its employment. The solution of tannic acid is, however, not open to these objections, and may occasionally be of service. Professional opinion is still divided on the value of intestinal antiseptics administered by the mouth. Soltau Fenwick⁴ has strongly recommended resorcin in doses of from two to five grains. It is soluble, sweet, and unirritating, and in his hands, combined with a preparation of bismuth, is said to have proved very serviceable. Other drugs with a similar action are creosote, thymol, naphthalin, benzol naphthol, and salol. Personally, I believe that all of these require caution in their use. In several cases I have witnessed a distinct depressing action follow their employment in the large doses frequently recommended. For the first few days of the disease, after the use of an efficient laxative and thorough lavage of the intestine, no means under our control are so effectual in checking the development of injurious organisms as limiting the dietary first to sterile water and afterward to a thin decoction of some cereal. Still later small quantities of a thin broth may be alternated with the cereal food. Lesage⁵ states that milk,

¹ New York Medical Record, February 12, 1898.

² Revue de Thérapentique, November 15, 1897.

³ Centralblatt für gesammte Therapie, 1896, vi. 321.

⁴ Loc. cit.

⁵ Loc. cit.

especially milk that has been partially changed by contact with digestive secretions, is an excellent medium for the growth of the virulent forms of the colon bacteria and for the production of their especial toxins. Bouillon does not favor the production of these virulent toxins. Moreover, infants suffering from acute gastro-enteritis, fed on broth, retain their general nutrition better than infants fed otherwise. Among the drugs most employed in the treatment of these affections at the present day are the salts of bismuth, which, in addition to their distinctly astringent effects, have also a sedative and slightly antiseptic action. Either the carbonate, the subnitrate, the salicylate, or the subgallate may be employed. They should be given in full doses (10 to 15 grains) suspended in mucilage with some aromatic water. In the later stages of the disease many Continental writers strongly recommend the employment of tannigen. Kraus¹ states that in cases of subacute and chronic gastro-enteritis the employment of tannigen gave excellent results. This drug is tasteless, and, therefore, easily administered, and it does not, he thinks, impair the gastric functions, nor does it produce any disagreeable or injurious after-effects. Its action proved distinctly beneficial in cases of follicular enteritis. The dose varies from 0.1 to 0.3 gramme (gr. ij to v) four times daily. It is advisable to continue the use of the remedy in diminished doses after the disappearance of the symptoms. Kraus quotes Biedert, who emphasizes the excellent results obtained from tannigen in the chronic intestinal catarrhs of children. Escherich ascribes to the drug a distinct disinfectant and bactericidal effect, and strongly recommends its administration in the same class of cases.

Recent writers agree that opium should be avoided at the outset of all forms of bacterial infection until the stomach and bowels have been thoroughly emptied by purgatives and lavage. It may then be employed, in small doses only,² to relieve colicky pain and to secure a moderate degree of rest for the infant. It is distinctly contraindicated where pain is only moderate and where the evacuations are foul-smelling and ill-digested and are not watery or very frequent, when the temperature is high, when cerebral symptoms are present, and when its employment is followed either by a rise in the temperature or by an increased offensiveness in the stools. Its deleterious effects are not so readily induced when the drug is given by the rectum, and this method of administration is often of the greatest value in ileo-colitis. Here the diseased condition is better treated by irrigation than by the administration of drugs by the mouth. Opium and starch injections (two or three drops of the tincture in a tablespoonful of thin starch-water) very gently thrown into the rectum, will often relieve the pain and tenesmus. In all cases opium should be

¹ Allgemeine Wiener medizinische Zeitung, 1896, vol. xli.

² Miller. Archives of Pediatrics, May, 1897.

given cautiously and never as an ingredient of the diarrhoeal mixture itself. Stimulants, in my opinion, are necessary in the majority of cases, and should be used cautiously at first, but liberally in the later stages when depression exists. Good whiskey and brandy are preferable to wines; aromatic spirit of ammonia may occasionally be of service in small, frequently repeated doses. Caffein may also be employed either in a simple solution or in the form of a well-prepared tea or coffee.

In all instances where the temperature runs an elevated course I have much confidence in the value of hydrotherapy. This treatment may be employed in the form of cool baths, the cold pack, or cool irrigation of the intestines. Of the three methods my preference is for tepid baths; whenever the temperature of the body rises above 102° F., the infant should be placed in a bath containing water at the temperature of about 95° F., which should be quickly lowered to 90° F., or 85° F., or lower if the temperature of the infant is not distinctly influenced. A cloth wrung out of cold water should at the same time be kept on the head. The infant should remain in the bath from three to ten minutes, the duration varying according to the infant's age and feebleness. It is to be remembered that infants are affected by a cold bath more promptly than adults and are more easily depressed by it. Care should be taken, therefore, to watch its effects and, if necessary, to use stimulants after it is over. Nichols¹ advises that baths for the reduction of temperature should be followed by injections of olive oil. This, if done, should be done quickly under a flannel or blanket covering the child. Over-fatigue of the infant is to be avoided. A cold wet pack may occasionally replace the cool bath with advantage where circumstances are not convenient for the employment of the latter. Of late years irrigation of the colon with cool water has been employed in cases of hyperpyrexia, and it is unquestionably a more powerful method than either bath or pack, and, when used with discretion, may prove of much value. Its action, however, is less under the control of the physician than that of baths, and serious depression of the nerve centres may result from its employment if too cold or too long continued. In conditions of exhaustion, especially when accompanied by the development of hydropcephaloid symptoms, much benefit may be derived from the subcutaneous injection of sterilized saline solution.² The solution employed may either be one of chloride of sodium, 7 grammes to 1000, or the artificial serum recommended by Hayem: sulphate of sodium 10 parts, chloride of sodium 3 parts, distilled water 1000 parts. These solutions must be sterilized and may be readily injected into the cellular tissue of the thigh or the back by means of a hypodermic needle attached to a Davidson syringe. The place of

¹ Pediatrics, June 1, 1898.

² *Thierseelen der Kinderarzt*, 1897, vii 11.

injection should be manipulated for a few minutes to facilitate absorption. Large quantities of the solution, at least 30 grammes, are to be injected three times daily. In these cases the absorption of this quantity of the fluid exerts a stimulating effect, and the author has frequently seen children in the last stage of marasmus, due to chronic gastro-intestinal infection, kept alive and finally recover under the use of these subcutaneous injections. Barbies and Derayer,¹ after a series of careful observations, corroborate the value of this method of treatment. They state that subcutaneous injections of from 20 to 30 grammes are followed by a period of reaction usually lasting about seven hours. The temperature rises from two-tenths to eight-tenths of a degree Centigrade; the pulse increases in strength and volume, and all the functions of the body appear to be stimulated. Both respiration and circulation are favorably influenced in collapse.

In the treatment of the chronic forms of this disorder, little good, and sometimes distinct harm, may result from the continued administration of the ordinary astringent, or even antiseptic, remedies. If drugs are to be given, only those which will not disturb the stomach and may to some extent improve general nutrition, such as the mineral acids, or one of the astringent preparations of iron, should be employed. Tannigen may also be of some service in these cases. Great attention must be given to the dietary, and the stools should be frequently examined to note if any special form of food fails to be digested. In general, fats should only be allowed with much caution, and starchy foods should be more or less predigested. Benefit may be derived from the employment of scraped meat, meat juice, broths, etc., and from the peptonized preparations of meat. For younger infants, milk food will require very careful modification and preparation, and in some cases it may have to be altogether discontinued. In older children milk food may be cautiously employed if a watch be kept for indications of undigested material in the stools. The dietary in each case must be decided by the digestive powers of the child. The most perfect hygienic conditions practicable must be secured, and especially abundance of fresh air. In the way of remedies our chief therapeutic reliance must be upon the administration of injections into the colon. After thorough irrigation of the bowel by simple sterile water, the injection of a weak solution of silver nitrate (gr. ij to Oj) may prove of service. Owing to the readiness with which the drug is decomposed, the presence, in any amount, of saline secretions or fecal matter will prevent its action. Preferable, in my opinion, is tannic acid (gr. xxx to Oj), or one of the drugs which contain it in solution, such as the fluid extract of hamamelis (5j to Oj); the colorless fluid extract of hydrastis has also proved of distinct service. In a discussion

¹ *Jahrbuch für Kinderheilkunde*, Band xlv. Hefte 3 and 4.

on intestinal hydrotherapy, at the New York Academy of Medicine, Dr. W. H. Thomson¹ stated that for many years he had treated the ulcerative conditions of the intestine, frequently following dysenteric attacks, by lavage of the entire colon with a disinfectant solution containing 5 to 15 minims of oil of peppermint to each pint. Recently he had employed Kemp's double-current irrigating tube in several cases, and was astounded at the ease with which large masses of mucus, and sometimes of membrane, could be removed. In inflammatory affections of the rectum and of the surrounding organs, continuous hot-water irrigation employed in the same way gave most excellent results.

Habitual Constipation. A troublesome condition often difficult to relieve is the habitual constipation occasionally met with during infancy. The difficulty in some instances would appear to be due to a peculiar anatomical condition which is said to exist in the early months of life,² in which there is an undue length of the descending colon and a folding of the sigmoid; sometimes there are two or three distinct flexures of the sigmoid instead of only one.³ This unusual condition, which may persist as late as the twelfth or eighteenth month, or even much later, retards the movement of the feces, favors the absorption of fluids, and leads to the formation of large hard masses difficult of expulsion. Constipation in these cases is best treated by massage and the daily employment of either enemata or suppositories. Southworth,⁴ in a paper read before the Section of Pediatrics, New York Academy of Medicine, states that he considers that it is to functional rather than to organic causes that the great majority of cases of constipation are due. Deficient muscular power, disturbed peristalsis, and altered consistence of the intestinal contents are the difficulties with which we have chiefly to contend. In all cases the feces should receive careful inspection, and in those which do not readily respond to careful management a more thorough analysis may be necessary. In breast-fed infants the percentage of fat and the total quantity of solids obtained by the infant are the important facts demanding our consideration. A too high percentage of the proteids tends to produce colic and loose movements, rather than constipation. A low percentage may injuriously influence muscular development. In these cases measures should be taken to alter the mother's milk. The quantity may sometimes be increased by supplying the mother with more fluid food; malt preparations are said to raise the percentage of fat. If the constipation be coincident with stationary weight, supplementary feedings of some artificial food are indicated. Too scanty a residue frequently induces constipa-

¹ New York Medical Record, February 12, 1898, p. 245.

² Treves. Marfan. *Revue des Maladies de l'Enfance*, April, 1896.

³ Jacobi. *Pediatrics*, July 1, 1898, p. 29.

⁴ *Archives of Pediatrics*, June, 1898.

tion. The stools in this case will be found to be made up of small, firm scybala which contain no curds and appear to be well digested. If, on the other hand, the infant although constipated shows a fair gain in weight, a small amount of fresh cream given just before nursing sometimes has an excellent effect. Regurgitation after nursing, however, would indicate that too large a quantity has been given. In artificially fed infants, constipation is also the frequent result of an insufficiency in the fat or proteids. Infants fed on many of the commercial foods, and especially on a dilution of condensed milk, are generally constipated on account of the low percentage of fats which these foods contain. The addition of a teaspoonful of fresh cream for each teaspoonful of condensed milk is often an effective way of relieving the difficulty. On the other hand, plain milk too little diluted is liable to yield an excess of indigestible casein, which occasions colic and sometimes constipation. In all these cases a properly modified milk is the best means for overcoming the difficulty. Should it fail to procure all the relief desirable, we may sometimes in addition make use of well-cooked oatmeal gruel as a diluent for the milk. Certain non-alcoholic preparations of malt possess laxative properties in part due to the malt sugars which they contain. Beef juice only occasionally produces a laxative effect. Stewed fruits and fruit juices may, after the first year, be cautiously tried; occasionally they are not well borne, and they may be followed in some instances by an urticarial or lichenous rash. Two special types of constipation demand notice. The first of these is the rachitic, in which an intestinal catarrh, by producing flatulent intestinal distention, frequently increases the defective muscular tone of both striped and unstriped muscular fibres. In these cases the diet will require regulation, especially in respect to the amount of starchy food permitted; the usual antirachitic treatment, including the administration of cod-liver oil, must also be instituted. A second class of cases is characterized by large, light-colored stools of the consistence of putty. Here dietary measures are imperative, but medicinal treatment directed to the intestinal catarrh and consequent hepatic torpor is of much importance. In all infants an effort should be made to secure the influence of habit, and the training of the bowels should begin soon after birth. The nurse should be instructed to hold the infant once or twice a day over a small chamber previously warmed by pouring into it hot water. Very soon the child will know what is expected of it, and will not soil the diapers. In children old enough to sit upon a chair when at stool a proper support should be furnished for the feet, otherwise the abdominal muscles cannot be brought into proper play. In many cases massage is particularly useful in training the bowels to act at definite periods. The writer describes an excellent method as follows: Placing the infant on its back with some light loose

covering over it, the operator, whose hand should be previously warmed, commences by applying the tip of the fingers at first lightly over the cæcum, describing small circular movements; then, continuing these movements, the operator should carry his hand slowly along the course of the colon till it descends into the pelvis. The proceeding should then be repeated, gradually increasing the pressure; resistance on the part of the infant's abdominal muscles may thus be avoided to a great extent. In infants only a few months old these movements should be made rather in a circle round the umbilicus than over the usual course of the colon. In general it is better that no lubricant should be used, as it is desirable that the tissues of the abdominal walls should move with the fingers upon the subjacent intestines. The séance may last five or ten minutes, and be repeated once or twice daily. At its conclusion the infant should be placed upon the chamber. Defecation is sometimes resisted by the infant, owing to the presence of a small fissure at the anus; should there be any indication of pain accompanying or following the act, careful inspection of the parts should be made. Filatow¹ states that congenital stricture of the anus or rectum is also an occasional cause of constipation in infants. Rectal examination in such cases may reveal a membranous septum, more or less occluding the passage. Marfan² has also put on record an instance of anal stenosis, due to cicatricial contraction following an operation for the relief of imperforate anus. He recommends that in infants the little finger should be introduced into the rectum, and a careful examination made. Physicians are too ready to yield to the temptation to prescribe drugs rather than to study out and remedy the essential causes of the constipation. At the outset, until habits and diet can be changed, laxatives may be demanded, but these should be decreased and withdrawn as soon as practicable. Malt extracts and cod-liver oil are sometimes efficient when nutrition is defective. For comparatively short periods enemata may be employed with advantage, but they are capable of abuse. When used daily the quantity of fluid should be small, the smallest that will stimulate the bowel to contract. Cold injections are more stimulating than warm. A saline solution is less irritating to the mucosa than plain water. A teaspoonful of glycerin in a tablespoonful of water is a stimulant and will frequently be found an excellent means of securing a proper evacuation. Crandall³ very pertinently states that there are few cases of habitual constipation which are not the result of a number of causes. One remedy or one measure used alone often fails. Treatment to be effectual generally requires to be prolonged, so that a carefully arranged plan must be systematically carried out.

¹ *La Médecine Infantile*, November 15, 1897.

² *Ibid.*, October 1, 1897.

³ *Archives of Pediatrics*, June, 1898.

Acute Intussusception. The subject of acute intussusception in young children has recently been discussed in several excellent papers. Gibson¹ has collected the details of 239 cases, and from these he deduces the following conclusions: The presence of a bloody discharge from the rectum is one of the symptoms most frequently met with, and when accompanied by abdominal symptoms of sudden onset, must be considered pathognomonic; its absence, or, in fact, the absence of any one of the symptoms generally regarded as typical, does not imply that intussusception does not exist. He calls attention to the infrequency with which fecal vomiting is recorded and to the value of careful palpation of the abdomen in arriving at our diagnosis. Absence of a clearly recognized tumor is not, however, proof that we have not to deal with an intussusception. According to his tables the mortality, including all cases, is 53 per cent. Of fifty-two cases collected from private sources by Martin² the average age was thirty months. Vomiting was present in 89 per cent.; bloody mucous evacuations in 87 per cent.; severe pain in 85 per cent.; tumor in 79 per cent., and tenesmus in 77 per cent. Two cases, both resulting fatally, were subject to medical treatment alone; two had no treatment, and both died; forty-three were treated by injections, and of these, fifteen were subsequently operated upon, and sixteen recovered from the use of the injections only. Of the fifteen in whom, subsequent to the use of enemata, laparotomy was performed, only three recovered.

TREATMENT. In discussing the treatment, Packard³ states that at no time can we be absolutely sure that no contraindications to an attempt at reposition exist. Only a short time must elapse after the intussusception forms before more or less constriction of the bloodvessels in the intussusceptum takes place, but it is impossible to make statements as to when it occurs. Many authors consider that the earliest time for the formation of adhesions is the third day, but others place it at the fourth. Records, however, from time to time appear which show that not only may adhesions form, but irreparable damage may be done to the invaginated bowel by the third day. For this reason great care is necessary in all attempts at reduction by mechanical means. Inflation by air has been almost entirely abandoned, on account of the practical difficulty in estimating the amount of force employed. Distention by fluid may be carefully attempted during the first forty-eight hours. "After this period has elapsed it is not likely to be successful except in those cases which are going to run a chronic course. Abundant hemorrhage seems to contraindicate any attempt at reduction by irrigation. On the other hand, absence of hemorrhage, associated with severe collapse, equally contraindi-

¹ New York Medical Record, July 17, 1897.

² Pediatrics, January 15, 1898, p. 77.

³ Therapeutic Gazette, March, 1898.

icates such an attempt, for it points to the early occurrence of gangrene."¹ Gibson² says, "Enemata are distinctly dangerous; literature is full of reports of cases of perforation or rupture of the intestines." He recommends that, in cases seen within forty-eight hours, as a preparatory step to immediate opening of the abdomen a preliminary attempt at reduction by irrigation should be made after the patient is anesthetized. The outlines of the intussusception should be carefully studied before the irrigation is begun, and while it is being used the operator should keep accurate track, by sense of touch, of the resulting distention and its influence on the intussusception, and he should remember that after attaining a pressure equivalent to that of a column of water three or four feet in height he is treading on dangerous ground. If as the result of the enema the operator feels sure that the intussusception has entirely disappeared, the operation may be postponed. Braun, however, many years ago called attention to the liability of being misled by the stretching of the sheath; an incomplete reduction will certainly lead to further trouble. Of the many fluids recommended normal saline solution at a temperature ranging from 100° F. to 105° F. would appear to be the best. Teed water enemas have been recommended. Packard³ says: "It is difficult to explain any advantage to be gained by such; it is inconceivable that cold or any other astringent could diminish to any extent the size of the intestinal plug, while it might seriously depress the vitality of the patient." When employing the irrigation the position usually advocated for the patient is on the back, slightly turned toward the left side, and with the hips well elevated. The fountain syringe is preferable to any depending upon hand pressure. The height at which the bag should be placed is extremely important. Most authors recommend an initial elevation of about three feet with a gradual increase until a maximum of perhaps six or eight feet has been reached. The extreme elevations recommended by some writers are to be distinctly condemned. Should the irrigation fail to reduce the intussusception completely, abdominal section should be performed at once, every care being taken to prevent shock from chilling of the body, hemorrhage, or prolonged manipulation of the intestines. Should success follow the irrigation, an opiate will be of service in lessening peristalsis and thus preventing recurrence.

Appendicitis. Appendicitis is admitted to be very infrequent in infancy and early childhood. Hutchison⁴ reports a case in a child two and a half years old, and Crozer Griffith⁵ reports two cases in children of four years. The onset in one of Griffith's cases closely simulated that of simple intestinal catarrh. Children are apt to have vomiting, diarrhoea,

¹ D'Arcy Power. *Edinburgh Medical Journal*, June, 1897.

² *Loc. cit.*

³ *Loc. cit.*

⁴ *Montreal Medical Journal*, February, 1898.

⁵ *Archives of Pediatrics*, August, 1898.

and abdominal pain from the disturbances induced by faulty digestion, and the pain of these may even be referred to the region of the cecum, without there being any other symptom to justify the diagnosis of an inflammatory lesion. In the second of Griffith's cases the inflammation arose as a sequel to an acute gastro-enteritis of a dysenteric type. It is admitted by all that the early diagnosis of appendicitis in such young children is accompanied by many difficulties.

Talamon¹ states that hysteria may occasionally complicate the diagnosis of appendicitis: periodic attacks simulating relapsing appendicitis may be purely hysterical in origin. He relates the case of a boy, aged only eight years, who had several nocturnal attacks simulating the organic disease, but in whom there were associated other distinct hysterical manifestations. These nocturnal attacks were cured by forcible suggestion and a threat of laparotomy if they continued. Occasionally a slight appendicitis in a neurotic subject may set up hysterical manifestations simulating diffuse perforative peritonitis, and thus lead to unnecessary alarm. French writers refer to a peritonitis produced by pneumococci, a condition which, like appendicitis, may require operative measures. Of fourteen cases, tabulated by Brin,² eleven were girls. He considers it probable that the diplococcus in these cases gained entrance through the vagina, especially as Boulay has demonstrated the presence of the diplococcus in the cavity and walls of the uterus. Clinically pneumococcus peritonitis always manifests itself as a circumscribed subumbilical peritonitis. It commences, like all acute cases of peritonitis, with violent pain in the abdomen, fever, vomiting and diarrhoea. These symptoms abate within a short time, the fever takes on a hectic character, and a tumor makes its appearance above the symphysis or in the vicinity of the iliac fossa, which may subsequently open in the neighborhood of the umbilicus. This localization is considered by Brin to be almost pathognomonic.

Idiopathic Dilatation of the Colon. This is a condition rarely met with. Martin³ has recorded the history of one case in which the condition was apparently of congenital origin. The patient was a boy aged three and one-half years. Rolleston⁴ classifies the recorded cases into those which are congenital, in which the symptoms occur at or soon after birth, and those which are acquired, in which the symptoms develop later, either some time after birth or in adult life. Various causes for the condition have been suggested, but no one treats all the cases satisfactorily. In some, an abnormal mobility of the colon or sigmoid flexure may be present, which predisposes to

¹ *La Médecine Moderne*, March 31, 1897.

² *La Presse Médicale*, February 27, 1897.

³ *Monmouth Medical Journal*, March, 1897.

⁴ *Practitioner*, August, 1897.

fecal accumulation; in others, there may be an inherent or acquired weakness and defective tone of the muscular wall of the intestine. Defective innervation has been suggested, but it is difficult to prove. The whole of the colon may be dilated, but the sigmoid flexure is almost invariably affected; from this point the dilatation extends backward to a varying length of the colon. These cases differ clinically from those of fecal accumulation, as the intestines remain in a paretic condition and are not subject to spasmodic contraction as in the latter class of cases.

TREATMENT. This is most unsatisfactory; purgatives and enemata have little action and lead to increased suffering. Opening the paretic colon in one of Osler's cases prolonged life for two years. Martin recommends that the ileum should be short-circuited into the rectum, inasmuch as the sphincter action of the anus would in this way be retained. Treves¹ performed this operation in a similar case, removing the whole of the bowel below the transverse colon. The result was apparently successful. In this case an examination of the bowel made it evident that the distention was not idiopathic, but was due to a congenital narrowing, regular and uniform in degree, of the lower end of the colon.

Acute Abdominal Distention. Still² calls attention to an acute abdominal distention which occasionally supervenes in the course of a severe illness, and generally, but not always, shortly before death. This form of abdominal distention may occur without obvious local cause; but in some cases it has been preceded by a diarrhoea, and should then more strictly, perhaps, be regarded as a complication of the secondary diarrhoea rather than of the original disease. Clinically this distention is of the greatest practical importance, for, although in some cases it seems to be merely a part of the process of dying, it certainly hastens death in almost every case, and in some it appears to be the actual determining cause of death. In every case it adds greatly to the distress of the child. This condition supervenes more frequently during the first three years of life than in older children. The onset of the distention is usually rapid. Its effects are chiefly manifested in an interference with the action of the diaphragm, as is shown by the rapid and labored respiration, but in some cases there is also interference with the action of the heart. The treatment must be prompt and vigorous. The child's shoulders should be raised; hypodermic injections of strychnine or brandy should be given; and if there be time, creosote in minim doses administered internally may be of service. Usually the child's condition is so urgent that local measures are imperative, but these are less useful than might be expected. The passage of a long, soft tube may bring away some of the gas, but more

¹ Lancet, January 29, 1893.

² Pediatrics, September 15, 1898.

frequently it fails, owing to the tortuous course of the sigmoid flexure. In those cases where the stomach or the small intestine only is involved, it is impossible to reach the distended portion.

DISEASES OF THE UPPER AIR PASSAGES.

Acute Osteomyelitis of the Maxilla. During the past year two cases of acute osteomyelitis of the superior maxillary bone have been recorded, under the title of *empyema of the antrum*, occurring in infants of an early age. The first case is reported by D'Arcy Power.¹ The infant, when seen, was eight weeks old and much emaciated. The right side of the face was distinctly fuller than the left, and presented an inflamed appearance. Pus was seen to be issuing from an opening at the bottom of the right lower eyelid and from the alveolar border of the upper jaw. The birth of the infant had been difficult and instruments had been used. When a month old the infant had had difficulty in closing its mouth, and had refused to nurse. The condition was treated surgically, but septiciæmia supervened, and the infant died thirteen days later. A somewhat similar case is reported by Douglas.² Such a condition would appear to be extremely rare.

Retropharyngeal Abscess. Several papers on retropharyngeal abscess have recently appeared. Huber³ states that these abscesses are more often met with laterally than in the median line. While it may be true that some may result from inflammation of the connective tissue posterior to the pharyngeal mucous membrane, the great majority, in this writer's opinion, are the consequence of an adenitis and periadenitis of the glands along the anterior aspect of the cervical vertebra. Clopott⁴ thinks the cause may, in a few cases, be traced to a suppurative otitis, and in some others to an attack of influenza. The principal symptoms which call attention to the disease are the interference with respiration and deglutition; the altered and somewhat nasal twang of the voice; the tendency to hold the head rigidly erect or to one side; and, generally, a swelling behind the sternomastoid or at the angle of the jaw. To give vent to the pus, both Huber and Clopott advise that the opening should be made from the inside. Huber recommends for the purpose a pair of dressing-forceps with sharp ends. The child, if it is practicable, should be held firmly on the lap of the attendant, while the left index finger of the operator is introduced into the mouth and rests upon the most prominent portion of the fluctuating mass; guided by the finger, the sharp

¹ British Medical Journal, September 25, 1897.

² Loc cit., February 5, 1898.

³ Archives of Pediatrics, June, 1897.

⁴ Jahrbuch für Kinderheilkunde, 1897, Band xlv. Hefte 3 and 4.

forceps is forced into the tumor and then opened. The head should be promptly inclined forward by an assistant, so as to favor the escape of the pus which wells up through the mouth. If the condition of the little patient is critical it is better to keep the child in the recumbent posture, with lowered head, while the opening is being made. If a knife be employed the danger of hemorrhage is greater, and the opening is more apt to close early. After the abscess has been opened the nasopharynx must be kept clean by instillation of normal saline solution and the internal administration of small doses of iron and potassium chlorate. Although such a wound may, in the great number of cases, heal kindly, yet it must always, in my opinion, present greater risk of infection than an external opening behind the sternomastoid, where all the surroundings can be kept aseptic. The prognosis is good. Huber says that of a large number of cases, some of them in a very bad condition, he can recall only one which terminated unfavorably.

Retro-æsoophageal Abscess. An interesting case was recorded by Crozer Griffith,¹ at the meeting in 1897 of the American Pediatric Society. The patient was a boy of twenty-one months, who, previous to his trouble, had been apparently healthy. Four months before he was seen he had had a troublesome cough, for which he had received no treatment. For the four weeks preceding his entry into the hospital his cough had a metallic character, and at times the breathing was noisy. Beyond a prolongation of expiration and the presence of coarse mucous râles, a careful examination of the chest revealed nothing abnormal. The diagnosis appeared to lie between bronchitis of a suffocative character, croup, and stenosis from mediastinal tumor or from tuberculous glands. The child gradually grew worse, and death took place ten days after admission. The post-mortem revealed an abscess lying in front of the upper thoracic vertebrae, which to some extent were eroded. The trachea had apparently lain immediately in front of the sac, while the œsophagus lay to the left and was closely adherent to its wall. Examination of the child's back showed no abnormal curvature in the spine. Crozer Griffith refers to the indefinite character of the symptoms which made an absolute diagnosis almost impossible. Analyzing the details of all the cases which he had been able to discover in the literature of the past fifteen years, he enumerates the more important symptoms observed as follows: Dyspnoea is noted as present to some extent in nearly all; generally it constitutes a prominent and urgent symptom, and appears to be the result of reflex irritation as much as of direct stenosis; cough is nearly always present, but is sometimes only slight; the voice is seldom affected, a sharp distinction from retropharyngeal abscess, in which the voice is

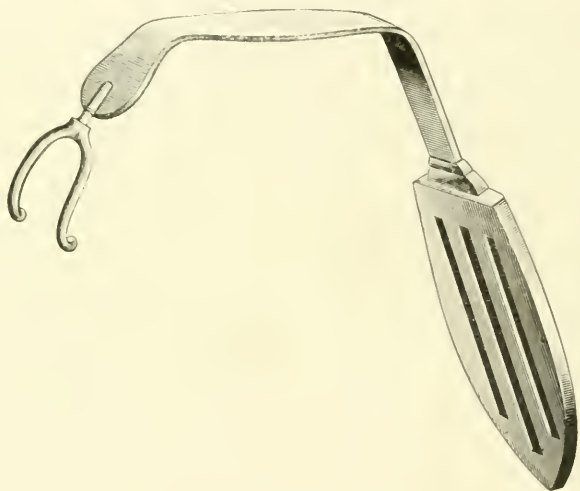
¹ Archives of Pediatrics, January, 1898.

so often thick and nasal. There is generally absence of dysphagia, due, doubtless, to the easy yielding of the tube to pressure; swelling in the neck occurred in only three cases; curvature in the dorsal or lower cervical region is apparently frequently absent.

Crozer Griffith considers that a clear distinction should be drawn between retro-oesophageal and retropharyngeal abscess, because not only are the symptoms entirely different, but the disease arises in a different place. In retro-oesophageal abscess the caries always occurs in the upper dorsal vertebrae, and possibly in the last cervical, but never higher as in the retropharyngeal abscess.

Examination of the Larynx. To overcome some of the difficulties met with in making an examination of the larynx in young children, Escat¹ has devised a peculiar form of tongue depressor, the extremity of

FIG. 1.



Escat's laryngoscopic tongue depressor.

which is curved so as exactly to adapt itself to the base of the tongue. On the further extremity a blunt fork is fixed, of which the two branches descend one on each side of the epiglottis, ending in two rounded points which, when the instrument is used, are supposed to lodge in the sinus pyriformis on each side of the laryngeal orifice. The instrument, therefore, serves not only to control the tongue, but to pull forward the opening of the larynx from the posterior pharyngeal wall, thus obtaining sufficient space for the introduction of the laryngoscopic mirror. In general, notwithstanding the use of this instrument, the examination must be forced; the child must be controlled by a sheet rolled round its

¹ Archives Internationales de Laryngologie, 1896, vol. ix. p. 479.

arms and legs, and must be carefully held on the knees of the assistant. A much simpler method to overcome the anatomical difficulties met with in young infants was demonstrated by Lack¹ at a meeting of the Laryn-

FIG. 2.



Diagram showing position of laryngoscopic tongue depressor during forcible examination of larynx in children.

FIG. 3.

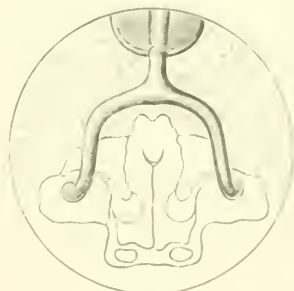


Diagram showing how the extremities of the fork rest in the *sinus pyriformis* when the instrument is properly applied on the tongue.

gological Society in London. No special instruments are required, and no force is employed. The infant is placed in the usual position for laryngoscopy, the index finger of the left hand is passed well into the

¹ Proceedings, 1897, vol. iv. p. 52.

mouth, and the terminal phalanx hooked around the hyoid bone, which is pulled forward. The rest of the finger acts as a tongue depressor, the knuckle as a gag, and the left thumb under the chin serves to steady the head; with the use of a small mirror the larynx can now be easily seen. The method causes no pain and requires no anæsthetic, while the younger the infant the less is the resistance and the easier the examination.

Congenital Stenosis of the Larynx. One of the rare conditions occasionally met with in infants is congenital stenosis of the larynx. A case is reported by the late Dr. O'Dwyer,¹ in which this condition was the cause of severe dyspnoea in an infant five weeks old. The stenosis was appreciated on exploring with the finger. Gradual dilatation was effected by means of urethral sounds, and then, with careful counter pressure on the outside, adhesions were easily broken up and the dyspnoea completely relieved.

Adenoid Vegetations in the Nasopharynx. This condition, frequently met with in children, has during the past few years received considerable attention. Goodhart,² writing on this subject, says that if any of the following symptoms are met with in a child, adenoids should be looked for: 1. Earache, especially recurrent earache, or, more important still, the presence of any discharge from the ear. 2. Impairment of hearing; a small cushion of adenoid tissue may, from its position, press on the Eustachian orifices and have a very definite effect upon the ear, even though there be no symptom of nasal obstruction. 3. Persistent enlargement of the cervical glands; in view of the risk of tubercular infection this must be regarded as important. 4. Defective expansion or development of the chest. 5. Any asthmatic tendencies.

On the other hand, adenoid vegetations may be present without giving rise to any symptoms of importance, and may in time entirely disappear.³ Goodhart considers that if none of the above symptoms are present, and the infant, when lying down, breathes comfortably and quietly through the nose with its mouth shut, any interference is unnecessary. He calls attention at the same time to the possibility, in the operation for the removal of these growths, of too vigorous scraping of the post-nasal tissues, giving rise in after years to the condition of "dry throat," with its accompanying troublesome ailments.

Mouth-breathing is not always solely dependent on the presence of adenoids. In older children⁴ we may find, in addition, a state of chronic nasal catarrh, with more or less hypertrophy of the mucous membrane of the nose or throat, or a highly arched palate with imperfectly devel-

¹ Archives of Pediatrics, January, 1898, p. 12.

² Practitioner, July, 1898.

³ McBride. Edinburgh Medical Journal, 1897, vol. xliii.

⁴ F. Huber. Pediatrics, October 1, 1898.

oped ethmoidal or sphenoidal sinuses, and deficient growth of all the bones in this vicinity. These conditions follow as a result of imperfect ventilation of the air-chambers due to the obstructed nasal respiration. In the removal of adenoid growths by one of the modifications of Gottstein's curette, Huber does not consider general anæsthesia necessary. The child is placed on the lap of the mother or attendant, and the head held firmly between the knees of the operator. R. C. Miles¹ recommends anæsthetizing the parts by means of a 20 per cent. solution of cocaine. This, in children, I should consider distinctly dangerous. I should also object to frighten any little patient of mine to the extent involved by such a bloody operation performed without narcosis. A general anæsthetic is, in my opinion, always to be recommended. Ether has the disadvantage of increasing the secretion of mucus from the throat, already very abundant in these cases. A mixture of chloroform and ether at the outset, followed afterward with pure ether, is certainly a much more convenient method of inducing anæsthesia in children. To insure greater safety, its administration may be preceded with a dose of strychnine.² It is important that the operation be done thoroughly, as the remnants frequently do not atrophy. In a certain, though small, proportion of cases recurrence of the growth takes place. In the experience of McBride³ the symptoms reappeared more frequently in those patients where no anæsthetic was employed than in those who were operated on under an anæsthetic, probably on account of the less complete removal of the growths. After the operation has been performed, and any accompanying nasal or tonsillar obstruction removed as far as may be possible, the mouth-breathing may still persist, owing either to a more or less permanent interference with the size of the bony air passages or to the impaired tone of the facial muscles which allows the jaw to drop. This may be remedied to some extent by tying up the jaw at night by means of a bandage or strap passing under the chin and over the vertex, combined with massage of the muscles affected, and by teaching the patients to breathe through the nose. Mr. Lane, quoted by Goodhart,⁴ makes the child lie on its back and breathe through the nose as a regular daily exercise. Any constitutional dyscrasia should be remedied by proper hygiene and, perhaps, by the administration of necessary drugs.

After an examination of 243 cases of adenoid vegetations, Louis Goure concludes that there is no bactericidal property in the secretion of the glands, and probably none in the nasal mucus. Careful examinations

¹ New York Polyclinic, 1897, vol. x. No. 1.

² See paper on "Anæsthetization of Children," by George Rowell, F.R.C.S. *The Lancet*, May 15, 1897.

³ *Edinburgh Medical Journal*, loc. cit.

⁴ *Practitioner*, July, 1898.

⁵ *Thèse de Paris*, 1897, No. 175.

of the growths themselves revealed, in only one instance, the presence of Koch's bacillus. Numerous other forms of bacteria were found, chiefly staphylococci, streptococci, and pneumococci. Goure considers that metastatic inflammations of the throat and larynx, and some cases of facial erysipelas, may be due to the presence of micro-organisms which find lodgement in these growths.

DISEASES OF THE RESPIRATORY SYSTEM.

Croupous Pneumonia. An interesting review is given by Kaler and Lefebvre¹ of a series of one hundred consecutive cases of croupous pneumonia occurring in early childhood. The statistics vary but slightly from those which have appeared from other sources. Two-thirds of the cases were males, and 12 per cent. of the children attacked were under two years; 48 per cent. were between two and six years, and 40 per cent. were between six and twelve years of age. In four-fifths of the cases the disorder appeared suddenly in children who had previously enjoyed good health. Among the initial symptoms, disturbances in the digestive tract were the most frequent; in 30 per cent. vomiting occurred; in 22 per cent., diarrhoea. Pain, referred sometimes to the side and sometimes to the epigastrium, was present in about 50 per cent.; headache was present in 40 per cent.; rigors occurred very seldom; herpetic eruptions were present in 20 per cent., making their appearance most frequently between the second and the fourth day. The position of the pulmonary lesion was at the apex in 48 cases and at the base in 46. Of those in which the apex was involved, 37 occurred on the right side and 11 on the left. Of those in which the base was involved, 18 were on the right side and 28 on the left. In 4 of the cases the stethoscope revealed no physical signs; in 1 the pneumonia appeared to be central, and in 1 it was migratory. The most constant physical sign was the bronchial breathing which was present in 85 per cent. of the cases; dulness was present in 75 per cent., and crepitant or subcrepitant râles in 66 per cent. Defervescence was abrupt in 48 per cent., less abrupt in 28 per cent., and occurred by lysis in 20 per cent. Out of the 100 cases there were 6 in which the disease assumed an abortive form, the fever disappearing between the second and the fourth day. In 11 cases the disease assumed a prolonged type, the physical signs persisting between two and three weeks. Complications were rare; in one case there was a dry pericarditis; in another, a suppurative pleurisy which disappeared after one paracentesis. In the one hundred cases there was only one death.

¹ *Revue de Médecine de l'Est*, 1898, v. 147.

Schlesinger¹ compares the peculiarities of croupous pneumonia in the child and in the adult, giving details of 173 cases. The temperature in children, he states, usually runs a distinctly higher course than in adults; the younger the child, the higher, as a rule, will be the fever. A pneumonia of the upper lobes is, in his experience, accompanied by a higher and more continuous fever than pneumonia of the lower lobes. Procrises, the morning remission occurring usually before the crisis, seem to be a peculiarity of childhood. At the time of the crisis the temperature and pulse generally fall together, but the frequency of the respiration falls more slowly. The pulmonary consolidation is not so markedly lobar as in adults; more frequently the consolidation is limited in extent; occasionally it extends beyond the boundaries of the lobe. Both lungs are not as frequently attacked in children as in adults; resolution progresses more rapidly, and protracted cases occur more rarely. Migratory pneumonia is generally fatal. The cerebral type of pneumonia is the most frequent anomaly met with in children. The most common complication is pleurisy, generally serous in character, but frequently developing into empyema. Albuminuria is more rare, and its consequences less severe than in adults. Hemorrhagic nephritis was observed in one case. Otitis media is of occasional occurrence, and generally runs a mild course, but may give rise to high fever and cerebral symptoms. Morrill² gives us an analysis of one hundred consecutive cases which occurred in the Boston City Hospital. His statistics closely resemble those of Kaler and Lefebvre. He calls attention to the confusion to which the term lobar pneumonia is liable to give rise in children. Broncho-pneumonia, he says, may be lobar so far as its extent is concerned and its exudate sufficiently fibrinous to mislead good pathologists; its fatality, however, is far greater. The use of the name lobar pneumonia is, therefore, liable to render statistics misleading. He prefers the term frank pneumonia.

Broncho-pneumonia. In an article on the *broncho-pneumonia of infancy* by West,³ the author states that he considers that under the term broncho-pneumonia two distinct clinical types of disease are included. The first is primary in its character; its onset is more or less sudden with high fever, and except for the physical signs, which are not distinct, it follows a course closely resembling that of lobar pneumonia. The second form is secondary to an attack of bronchitis, or to some affection of the mouth or upper air passages. The disease runs a slow course, with an irregular temperature, and its mortality is high. Bacteriological evidence indicates that in the primary form the pneumococcus is the important cause, while in secondary broncho-pneumonia the streptococcus is the

¹ Archiv für Kinderheilkunde, 1897, xxii. 3.

² Archives of Pediatrics, October, 1897.

³ British Medical Journal, 1898, No. 1952.

organism most frequently met with. The first form he considers closely allied to ordinary croupous pneumonia, and would reserve the name broncho-pneumonia for those inflammations of the lungs which are secondary to antecedent affections of the bronchi, and whose exciting cause, for the most part, is some other organism than the pneumococcus. Carmichael, in a paper read at the last meeting of the British Medical Association, differentiates clinically four types of pneumonia in children. In the first form or type he places the true croupous variety, distinct and definite both in its clinical relations and pathology. Its chief clinical features are sudden invasion, complete consolidation with no indications of bronchial catarrh, rapid crisis taking place in from seven to ten days, and general symptoms proportionate rather to the toxæmia than to the degree of lung involvement. In the second type the clinical features are those of a bronchial catarrh involving the minute bronchial ramifications, but in which no indications of consolidation can be made out. The physical signs are distributed generally over both lungs. The type of fever and course of the disease are similar to those of the next division. In the third form the symptoms are also those of a bronchial catarrh, sometimes confined to one lung, but often extending over both, with, in addition, small areas of incomplete consolidation which may be detected by the stethoscope. The onset is gradual, not sudden; the type of temperature irregular; the duration of the disease from ten to fourteen or twenty-one days, ending by lysis, very rarely by crisis. The auscultatory signs typical of this form are limited areas of broncho-vesicular breathing with increased vocal resonance, and fine crepitations are heard both with inspiration and expiration. In the fourth type we also have symptoms of a general bronchial catarrh, but associated with it we find larger areas of incomplete consolidation. The auscultatory signs are similar to those of the third type, with the difference that percussion is notably impaired in proportion to the extent of lung involved, but the dulness is not so absolute as in the fibrinous form. Of 142 hospital cases during the past five years, 107 showed the clinical features of a broncho-pneumonia of one of these types, while 35 showed all the features of the fibrinous form. This accords with the universal experience that the acute pneumonia of infancy and early childhood is, in the majority of cases, a broncho-pneumonia as opposed to the croupous form more commonly met with in the adult. The explanation lies in the anatomy of the part. Infection by micro-organisms always attacks the most vulnerable tissues, namely those possessing the least immunity. Recent investigations show that during the early months of life the delicate tissues constituting the alveoli of the lung are but imperfectly developed. The connective-tissue cells in the stroma, and the epithelial cells in the ultimate bronchial ramifications, are very vascular and readily

proliferate. Not until the fourth or fifth year of extra-uterine life do the delicate tissues constituting the alveoli of the lung become fully developed. The presumption is, therefore, that these growing and immature tissues possess less immunity to the inroads of infective micro-organisms than the fully developed structures of the adult lung. Recent investigations would indicate that quite a number of micro-organisms are met with in the various forms of this disease. In the primary croupous pneumonias Fränkel's or rarely Friedlander's coccus is the predominating form. In the primary catarrhal pneumonias one or other variety of pneumococcus may be found alone; more rarely, the streptococcus may also be present. In the secondary pneumonias the streptococcus is frequently met with, but other organisms are not uncommonly present. Bacteriology thus shows that acute pneumonia is in no sense a specific disease produced by any special organism.

Elsner,¹ in a paper founded on one hundred and fifty cases of the disease observed by himself, states that the most difficult cases to diagnose are those of *central pneumonia* occurring in children, without chill, and where there are marked gastric symptoms, slight jaundice, and abdominal distress and pain; the persistently rapid respiration with elevation of temperature, however, should excite suspicion as to the true nature of the case. It is also to be remembered that pneumonia in children sometimes develops an *intermittent* type in no way dependent upon malarial infection. Tordenus² reports a case in which lobar pneumonia developed in a well-nourished child of six years. The onset was severe and sudden, with a temperature of 104.7° F. On the following day the morning temperature was 100.4° F., the evening temperature 101.4° F. The third day showed a drop to 99.5° F., with an evening rise to 104.9° F. On the fourth day the morning temperature was 98.4° F.; after which no further rise occurred. Recovery was rapid and complete. The variations were in no way due to the treatment, which was purely expectant. Pneumonia, in which there has been a *direct infection by streptococci*, has characteristic features of its own which have been described by Denny.³ The onset is generally more gradual, the sputum is more purulent and less rusty, and contains streptococci as well as pneumococci. Physical signs are usually late in appearing, and there is a marked tendency for the local process to wander, so that the auscultatory signs are of a shifting character. The cough is unusually troublesome and persists as long as the physical signs remain. Convalescence is very slow, and it may be months before the patient recovers from the effects of the disease. With reference to the *contagious character of pneumonia*,

¹ Medical News, lxxii. 633.

² Journal de Clinique et de Thérapeutique Infantile, v. 32.

³ Boston Medical and Surgical Journal, April 14, 1898.

instances increase in which it is noted that several members of a family are successively attacked by this disease. Variot¹ records two cases in which infants lying in contiguous beds in the ward of a hospital contracted pneumonia a few days after the first case. He does not consider that the transmission of germs was direct, but in all probability by means of some intervening object.

TREATMENT. In the treatment of an attack of acute pneumonia the paramount importance of pure air for the patient and of careful nursing, with a just estimation of the value of rest, are to be emphasized. No unnecessary or disturbing medication should be permitted. Symptoms of gastric irritation or constipation at the onset may be relieved by small hourly doses of calomel, and subsequently, if necessary, by glycerin enemas. For the first forty-eight hours a simple mixture containing citrate or acetate of ammonium, with either aconite in small doses or spirit of nitrous ether, may be employed. Expectorants should not be given. The diet should be liquid and at the first very light; water to drink should be allowed freely. Later on in the disease, should the pulse show any indications of weakness, small doses of strychnine (gr. $\frac{1}{200}$ to an infant one year old, or gr. $\frac{1}{100}$ to a child of four years) may be given every six or eight hours. Should the case be one of broncho-pneumonia, or the symptoms look serious, digitalis or strophanthus in a prescription by itself may be employed in the following manner: for a child of four years, $\mathfrak{m}ij$ to v , every three hours for four doses; afterward only every eight or twelve hours. A stimulant, in the form of either brandy or whiskey in moderate doses, may frequently be demanded. In the catarrhal forms its use, in my opinion, should be commenced early. Should the heart show great signs of weakness, hypodermic injections of strychnine or ether may be employed. The cold pack or bath has been strongly recommended in acute attacks. I cannot but feel that in croupous pneumonia, which nearly always terminates favorably, it is a mistake to insist on reducing what may be called the normal temperature of the disease. In those cases, however, where the child is restless and uncomfortable, or nervous symptoms appear as the result of high fever, the temperature undoubtedly should be lowered. In my own practice the tepid bath at a temperature of 85° to 90° F. has often proved valuable in these cases, reducing the fever and allaying the nervous symptoms. Water of this temperature appears to act much more efficiently in children than it does in adults. Where this, however, does not succeed, we should not hesitate to proceed to the use of colder temperatures. Vigorous friction over the surface of the body should be maintained while the child is in the bath. As a precaution against collapse the bath ought not to last longer than

¹ Journal et de Clinique de Thérapie Infantile, 1898, No. 13, p. 246.

five minutes, and on no account should it be pushed if the child shows signs of cyanosis. Reaction in such cases should be assisted by hot-water bottles applied to the feet, and, perhaps, by the administration of a stimulant either before or after the bath. In reference to reaction, Baruch¹ says that reaction must always be provided for by friction during the bath, so that there should be no need for warmth and friction afterward. Reaction may be enhanced also by modifying the temperature of the water, not, as is often erroneously done, by elevating it, but by lowering it within reasonable limits, at the same time shortening the period of the immersion. It is a law of hydrotherapeutics that low water temperature, strong mechanical impact, and brief duration, promote reaction. Smith² prefers to the bath the application over the thorax of cold compresses at a temperature varying from 65° to 70° F., according to the severity of the case and the effects produced. Such compresses should be changed every hour until the temperature in the rectum reaches 101° F., and should then be discontinued. This treatment, he states, although it has little effect on the local process, is very comforting, quieting nervous manifestations and inducing sleep, while at the same time it strengthens the pulse. In severe broncho-pneumonia the use of the cold bath or compress, or of the cold pack, is more imperatively demanded than in croupous pneumonia. Baruch,³ in a paper on the treatment of pneumonia, writes that in his experience full baths are too disturbing to most children over three years of age. A younger child will become quiet as soon as it experiences relief in the bath, while the older child often continues to struggle and scream. Nevertheless the bath must be insisted upon in every case where other methods prove inadequate. The toxins of pneumonia appear to endow the patient with less resisting power against the effects of cold baths than do the toxins of typhoid fever; therefore, full baths colder than 75° F., and longer than eight minutes, should be avoided. In children above three years of age the chest compress is, in Baruch's opinion, the most useful and practicable method of applying cold. The compress consists of three folds of old linen, wrung out of cool water (65° to 75° F.), sufficiently long to nearly encompass the chest and to extend from the clavicle to the navel, and it should be applied over the front of the chest so that the edges reach nearly to the spinal column behind. Over this a flannel binder is to be applied to hold the compress snugly in position. The compress is to be changed every hour or oftener, till the temperature falls to 100° F. The changes should be made with as little disturbance of the child as possible. Holt⁴ writes, "Hyperpyrexia, in my opinion, is best controlled by the cold

¹ Medical News, November 19, 1898.

² New York Medical Record, February 19, 1898.

³ Medical News, November 19, 1898.

⁴ Loc. cit.

pack. The child is laid upon a blanket, with all clothing but the napkin removed. It is then rolled in a wet sheet, and rubbed with a smooth lump of ice over the trunk. The blanket is then brought together and pinned beneath the chin without removing the wet sheet. This rubbing with ice is to be reapplied every half-hour or every two or three hours according to the symptoms. The pack may be continued for two or three days at a time." In the case of children, and especially of infants who are extremely dyspnoeic, cyanosed, or pallid, and apparently nearing death, Crozer Griffith¹ recommends a plunge into a bath of 105° or 106° F. This, he says, will often act as a prompt stimulant, and under it the blue color will disappear and the respirations improve. The hot bath may also be employed in other conditions where death seems imminent from failure of respiration. In some cases hot baths (temperature 100° to 104° F.) employed from the outset prove of much value in the treatment of broncho-pneumonia in very young children. Desmons² strongly recommends their use, repeating them every three hours or, in severe cases, every two hours. If employed at the very onset of the symptoms he states that an attack may frequently be aborted.

As yet no dependence is to be placed upon pneumonia antitoxin, introduced a short time ago.

The value of inhalations of oxygen for cyanosis is not to be forgotten. Although of late years there have been powerful advocates for bleeding in certain cases of acute pneumonia in the adult, its employment in children has not been so strongly advocated. Baginsky³ strongly urges that as a last resort, after all other measures have failed, venesection should be tried. He records three cases in which life was apparently saved by this means. The effect, he states, is purely mechanical. In his cases the cyanosis decreased almost at once, the pulse became more palpable, and the dyspnoea was lessened within a few moments after the vein had been opened. Venesection has proved of little service, however, in cases in which the reserve force of the patient has already been spent, or in which the poisonous effects of the toxins have been too intense.

Serous Pleurisy. For many years past paracentesis in cases of serous pleurisy has been considered to be the correct treatment. Talamon⁴ questions the advisability of this procedure, and says that a pleurisy which has not been tapped is, in his opinion, recovered from better and more completely than one which has been tapped. Effusions not tapped, he thinks, often disappear completely; but he adds that he has never seen a patient treated by paracentesis leave the hospital absolutely cured. He also considers that paracentesis favors the absorption of the micro-

¹ Medical News, December 3, 1896.

² Le Nord Médicale, December 15, 1897.

³ Berliner klin. Wochenschrift, May 23, 1898, No. 29.

⁴ La Médecine Moderne, March 9, 1898.

organisms contained in the fluid, and may, perhaps, hasten general tuberculosis. No statistics are given, and we must, therefore, receive his statements with caution.

In a paper read before the American Pediatric Society, Scharlau¹ gave a brief synopsis of fifty-six consecutive cases of empyema operated upon during the previous year in Mount Sinai Hospital, after a uniform plan, namely, primary excision of a rib in every case. Eighteen died, a mortality of 33 per cent. Scharlau stated, however, that sixteen of the deaths were from causes which apparently had no connection with the surgical procedure. In the discussion which followed, the opinion was general that, in the majority of cases, the simpler operation of incision is all that is necessary. Holt stated that in his experience cases in which a simple incision only was made recovered more quickly than those in which an excision of the rib was performed. According to Koplik, if the child is under a year in age, or if it is in a weak condition, simple incision, at least for the primary operation, is better than excision. In those who are stronger, or in cases where the empyema is of long standing, excision affords an opportunity for the more complete evacuation of tough clots should such be present.

Empyema. Empyema in children should not be a particularly fatal affection, provided that an early diagnosis is made and that prompt measures are adopted for the removal of the purulent matter. Although it is, perhaps, possible for small effusions to be absorbed, it may be laid down as an axiom that when pus is present the only rational treatment is evacuation. There still appears to be some difference of opinion, however, as to the best method in which to effect its removal. From a sifting of the mass of evidence on the subject² it would appear that incision and drainage should be the treatment pursued with children up to the end of the second year; after this age the surgeon must be guided by the conditions present, and perform resection, if he deems it advisable. The death-rate from infancy to the age of three years is very high, nearly 50 per cent., but after this age the prognosis is more favorable. The use of chloroform during the operation is not contraindicated. Winters advises that full anaesthesia should not be induced, as it is desirable that the child should cough, and by the explosive expiratory effort forcibly expel the pus from the pleural sac. The after-treatment must be left to the discretion of the medical attendant, and should be conducted on ordinary surgical principles.

It is not to be forgotten that sometimes simple paracentesis may be successful in completely curing an empyema. Variot records two cases of empyema in which complete recovery took place after two carefully

¹ Archives of Pediatrics, August, 1897.

² Pediatrics, August 15, 1897.

³ Journal de Clinique et de Thérapie Infantile, 1898, 11, 202.

performed paracenteses. He considers that in children in whom the general conditions are good this method should be given a trial before we proceed to more severe operation.

In an interesting article, Caillé¹ discusses the significance of *fever following operations for pyothorax*. In many cases, he says, some rise of temperature takes place after the operation, and while the explanation of this may in some cases be extremely simple, in others it is exceedingly difficult. Among the many causes to which, in his experience, the rise may be attributed, he mentions intoxication by absorption from iodoform or carbolic-acid dressings, constipation, secondary and extrathoracic abscesses, infection from some specific contagion, an unresolved lobar pneumonia or broncho-pneumonia, general septic infection, and, sometimes, deep-seated multilocular accumulations of pus not reached by the primary operation. Of the latter he says that not a few have come under his notice. In one instance the aspirating needle, several times carefully inserted, failed to detect a deep-seated pus deposit which was strongly suspected and which finally found its way to the chest-wall. Caillé also calls attention to a class of cases which do well for several weeks, and then show an irregular rise of temperature, although no local or general complications can be detected. If, in these cases, the drainage-tube is removed and the patient taken out of doors in spite of the fever, we generally get a rapid and satisfactory improvement. The successful management of pyothorax, he says, is not alone a matter of incision and drainage, but often calls for accurate clinical investigation and observation. A careful record of temperature should be kept for many weeks.

Adams,² in a paper read before the American Pediatric Society, has emphasized the value of the somewhat novel method of treating cases of empyema, after operation, by submerging the body of the patient in a bath of warm water. After quoting from a paper by Zeman, who first advocated the method, he describes its employment in a case of his own at the Children's Hospital in Washington. Its value consists in its being a simple, clean, easy, and very effectual way of washing out the pleural cavity after it has been opened. The force of the inflow of water with each inspiration is much greater than that obtained by means of any ordinary irrigator, and expiration drives out many tough, stringy masses which had not been affected by irrigation previously employed. The bath should be given at a temperature of 100° F., and the water should be rendered aseptic by previous boiling. In some cases an antiseptic may be added, but this is unnecessary. The quantity of water should be sufficient to reach a few inches above the wound, and the child should be kept in it from ten to twenty minutes, until the water, with each expiration, returns clear.

¹ Archives of Pediatrics, August, 1898.

² Loc. cit.

Bronchiectasis. Slight bronchiectasis is not rare in children; large bronchiectases, on the other hand, are exceedingly rare. Heintze¹ records a case of very severe bronchiectasis in a child of three years, who had had frequent attacks of bronchial catarrh since its first year. Tubercular infection subsequently took place, from which the child died.

Tuberculosis. With reference to the *mode of entrance* of the *tubercle bacillus* into the human subject during infancy, several very important statements have been made during recent years relative to the danger of infection through the alimentary canal by the milk of tuberculous animals. While such danger unquestionably does exist, nevertheless the frequency of infection from this source is doubtful, and Holt,² after a study of one hundred and nineteen autopsies of infants and young children, reaches the conclusion that infection through this channel is rare and does not exceed 1 or 2 per cent of all the cases met with. In the vast majority he considers that infection enters by the respiratory tract. Northrup, in a recent address before the Philadelphia Pediatric Society, reasserted the frequency and the importance of this latter path of entrance, and stated that "in the vast majority of cases of tuberculosis in children the seat of the primary infection is the lymph nodes clustered about the bifurcation of the trachea and the roots of the lungs. Tubercle bacilli enter the respiratory passages with the inspired air, lodging in the mucus of the air-passages or the alveoli of the lungs. They may pass through the mucous membrane at any point, be taken into the lymph spaces, traverse the lymph canals to the nearest nodes, and be retained. Their subsequent career depends upon the power of the tissues to withstand their tendency to grow and reproduce the lesion in which they were bred." A mode of occasional entrance not sufficiently emphasized is through cavities in carious teeth. Starek³ examined one hundred and thirteen children with cervical adenitis, and found that 41 per cent. had carious teeth, and in almost every instance the enlarged gland corresponded to the seat of the carious tooth. He mentions two cases of tubercular adenitis, in one of which numerous tubercle bacilli were found in the carious teeth, and in the second tuberculous granulations at the bottom of a carious excavation were discovered. Infection may also be conveyed from the crypts of the tonsils to the glands of the neck. The diagnosis and treatment of tuberculosis in children are not essentially different from those of the disease in the adult.

Asthma. Discussing the etiology of asthma in children, Kissel⁴ believes the simplest and most accurate view to be that asthma is an

¹ Deutsche medicinische Wochenschrift, 1898, xxiv, 40.

² Medical News, December 12, 1898.

³ Revue de la Tuberculose, July, 1896.

⁴ Archiv für Kinderheilkunde, xxiv, 172.

independent neurosis which expresses itself in paroxysms of dyspnoea. He regards as problematical the connection between bronchial asthma and the disturbances of nutrition met with in rhaehitis and tuberculosis, or associated with previous attacks of measles and whooping-cough. Disease in the bronchial glands, he considers, may sometimes give rise to attacks of dyspnoea or to symptoms which resemble whooping-cough, but which very rarely take on the character of true asthma. Kissel carefully examined the bronchial glands in every autopsy he performed, and while he not infrequently met with enlargement, he was unable in these cases to make out any previous history of asthmatic attacks. He acknowledges, however, the possibility of a reflex asthma due to irritation of the mucous membrane of the nose, and adds that Henoeh has observed several cases of dyspeptic asthma and bronchial asthma in young children. Judging from statistics, he regards true asthma in children as an affection rarely met with.

DISEASES OF THE CIRCULATORY SYSTEM.

Arhythmia. In view of the greater irritability of the nervous system in children as compared with adults, it is not surprising that in the former the heart shows a greater liability to arhythmical action. While it is never to be forgotten that such irregularity may be a symptom of grave organic disease, yet we must remember that arhythmia in early childhood may in many cases be of a transitory and even of a physiological character. Comby¹ draws attention to the principal conditions producing such arhythmia in children, and points out that the treatment is essentially that of the primary condition. Arhythmia, he says, may occur sometimes in healthy children under conditions which may be regarded as physiological. Emotional states may produce it. It has been observed during sleep, and it occasionally follows a warm bath. Arhythmia may be occasioned by the untoward action of various drugs, such as opiates, or digitalis, stramonium, etc., and it may also arise from various digestive and intestinal disturbances, and is probably due, in these cases, to a form of auto-intoxication. When associated with headache and vomiting, it may suggest a meningitis, but the rapid disappearance of these symptoms on the administration of a purgative, or as the result of intestinal disinfection, will simplify the diagnosis. Arhythmia is sometimes met with as a consequence, apparently, of certain constitutional states, such as diabetes, chlorosis, and rickets, and it has also been noticed in thin, rapidly growing children during the school period. In chorea and in other neuroses, though there may be no evidence of endocarditis, it is occasionally

¹ *La France Médicale*, September 3, 1897, p. 565.

present, and, although seldom observed during the development or height of the infectious diseases, it is not infrequently noted during convalescence from acute febrile ailments. When, however, it occurs after a diphtheria, even in the absence of febrile symptoms, convalescence can scarcely be considered as established. Heubner,¹ in discussing the etiology of arrhythmia, refers many of the cases to an irritation of the cardiac centre. This is certainly the explanation in meningitis. Where the arrhythmia is due to some toxic influence, he says that we may assume there is some specific action either on the nerve-centres or upon the heart-muscle. Arrhythmia in chronic cardiac disease he has observed only in the stage of insufficiency. In rapidly growing anemic children, he thinks a possible explanation may exist in the relatively small arterial system which investigation shows is present in them.

Cardiac Complications in Rheumatism. Several papers have recently appeared on the *disastrous influence in early childhood of the rheumatic poison on the heart*. Chandle² emphasizes the importance of the early and correct diagnosis of rheumatic fever in young children, since the risk of cardiac complications in this disease may be said to be in inverse proportion to the age of the patient. Unfortunately, its early diagnosis is far more difficult in the young than in adults, and we frequently find that in children its existence has been overlooked until the fact of its previous occurrence is recognized, at a later date, from the grave results which have ensued. It should be remembered that in the acute rheumatism of early life the tendency to arthritis is at its minimum, while the liability to endocarditis, pericarditis, and subcutaneous tendinous nodules is at its maximum. This is also true in a great measure of the tendency to pleurisy, tonsillitis, and the vasomotor and hemorrhagic phenomena, namely, erythema and purpura; all of which become infrequent after the age of puberty is passed. In the acute rheumatism of adults it is arthritis, while in that of children it is carditis, which plays the most important part. There is also a special tendency in childhood for the various affections to arise independently and apart from one another, so that an endocarditis or pericarditis may occur, not only without any accompanying joint affection to suggest its existence, but, in rare instances, without other rheumatic phenomena to give warning of its presence. There is always a strong *prima facie* presumption for a rheumatic origin in every case of endocarditis or pericarditis occurring in childhood, and in the presence of any ailment which might by any possibility be of a rheumatic character careful examination of the heart should be made. This is especially important in the case of children

¹ Zeitschrift für klinische Medicin, December, 1894.

² Treatment, November 22, 1897.

who have had previous signs of rheumatism or who have any family predisposition to the disease. Broadbent¹ states that it is of the first importance that any indications of trouble threatening the heart should be recognized as early as possible, so that due precautions may be taken. In severe cases nothing appears to exert any controlling influence on the course of cardiac inflammation in children when once it has gained a firm hold. With any suspicion, therefore, of rheumatic trouble, the patient should be kept under careful observation, and the heart should be examined frequently for some weeks. Exposure to cold should be guarded against, and exercise should be limited in amount for many weeks after all apparent symptoms have subsided. Broadbent agrees with Cheadle in attaching a distinctly evil prognostic significance to the appearance of rheumatic nodules. These nodules are small fibrous growths, generally of the size of a split pea, but sometimes larger, which are occasionally found over the olecranon or condyles of the humerus, on the edges of the patella, in the scalp, especially over the occipital bone, over the malleoli, on the finger-joints, or on the sheaths of tendons. The skin over them is freely movable, and they are best seen by flexing the joint over which they are situated and thus rendering the skin tense. According to these writers, the nodules mean persistent cardiac disease, generally uncontrollable, and proceeding almost infallibly to a fatal ending. Of evil significance, also, but in less degree, is an exudative erythema, which generally appears in the form of small raised patches with sharply defined margins and of a dull-red color. The centre of the patch may show indications of absorption, while the margins may continue to spread. This eruption is usually accompanied by some rise of temperature; it lasts a few days, and leaves behind it a slight brownish discoloration. Should either of these conditions be present the child must be kept in bed, the heart carefully examined from time to time, and the morning and evening temperatures, together with the rate of the pulse and respirations, should be taken daily until all ominous signs have disappeared. Broadbent quotes Sturgis as saying that it is rare for the victim of endocarditis in childhood wholly to escape pericarditis.

At the last meeting of the British Medical Association, Lees² read a very interesting paper on this subject, in which he also emphasized the virulence of rheumatic carditis in childhood. He stated that in nearly one-third of a series of one hundred and fifteen cases of fatal rheumatic heart disease in children (taken in great part from the records of the Great Ormond Street Hospital), the fatal attack was the first that had occurred; in 85 per cent. of the cases the history indicated that death

¹ *Edinburgh Medical Journal*, May, 1897.

² *British Medical Journal*, October 15, 1898.

was caused, not simply by previous heart disease, but in great part by a recent toxic process. This fatal result, in his opinion, was brought about by the direct and pernicious action of the rheumatic poison upon the heart muscle, and was not due merely to endocarditis. In these post-mortem records pericarditis, rather than endocarditis, was the more striking lesion, and apparently contributed more definitely to the fatal results. It is remarkable, however, how rarely an effusion into the pericardial cavity of any great amount is recorded. Although in only nine out of a series of one hundred and fifty recorded post-mortems of fatal rheumatic heart disease in children, is it stated that the pericardium was healthy, in only thirty-eight out of the same series is it noted that any fluid at all was present in the pericardial cavity, and in many of these the amount was small; in not more than twelve was the quantity estimated at more than two ounces, and in only six at more than three ounces. The highest estimates were five and six ounces, and each of these quantities was found in only one instance. On the other hand, in seventy-seven cases adhesion of the pericardium was complete over the whole surface of the heart, and more or less present in one hundred and thirteen. These facts show that pericardial effusion in rheumatic fever in children is of much less frequency and importance than would naturally be inferred from the statements of the text-books. The disastrous effects, therefore, of pericarditis in children are not produced by mere effusion of fluid, but rather by direct injury to the heart produced by an associated myocarditic inflammation. Lees stated that in his opinion the main factors responsible for the mortality and for a great part of the cardiac crippling in those who survive were pericarditis of a plastic type and cardiac dilations. Murmurs he considers as of comparatively small importance in the immediate prognosis, but evidences of pericardial friction or of cardiac dilatation are to be regarded as possessing a most serious import. Dilatation, in his experience, is a not infrequent condition in rheumatic cases, and is by no means limited to those cases which suffer from pericarditis, though it becomes more pronounced when pericarditis is present. This dilatation, he considers, is due to the direct toxic action of the rheumatic poison on the cardiac muscle. A similar acute dilatation, in his opinion, frequently occurs in influenza and is often the cause of severe symptoms, sometimes of a fatal result. Both in influenza and in rheumatism the cardiac dilatation may persist after the attack is over, producing symptoms of gradually increasing cardiac failure. I have seen cases in which a dilatation caused by a first attack had not subsided when a second attack occurred. The dilatation under such circumstances may become very considerable. In the light of these post-mortem records, Lees considers that any very rapid increase in the area of precordial dulness during an acute rheumatic attack is to be regarded as

due in great part to dilatation ; only in a slight degree is it to be attributed to effusion into the pericardium. In chronic heart disease the result of previous rheumatic attacks, chronic cardiac dilatation plays an important part. When external pericardial adhesions exist, fixing the heart to the sternum, the pleura, and the lungs, there can be little doubt that an injurious effect is produced, especially if they at all constrict the great vessels ; it is doubtful how far simple adhesions between the two pericardial surfaces do harm, except in rendering permanent an acute dilatation. Lees asserts that the prognosis in rheumatic heart disease in young children is not to be deduced from a consideration of the valvular lesions believed to be present, except in the rare instances of advanced mitral stenosis, but should be founded mainly on three facts : the amount of cardiac dilatation, the presence or absence of pericarditis, and the evidence of a fresh rheumatic toxæmia, as shown by sore throat, erythema, rheumatic nodules, arthritis, and chorea.

Tuberculosis of the Myocardium. This is a condition that has hitherto received comparatively little attention in pediatric literature, although it is essentially a disease of youth. As long ago as 1826, Laennec asserted that tubercle attacked the heart, but did not cite an instance. We have now on record some forty well-attested cases. From them we learn that the myocardium may undoubtedly be affected with tuberculosis without any disease of the pericardium or endocardium, and this obtains even in cases where the myocardium is extensively involved ; conversely, the myocardium may be comparatively healthy, or, at most, present symptoms of fatty degeneration, while the pericardium and endocardium are tuberculous. There is to this degree a pathological independence between the myocardium and the two serous layers that line it. Labbe¹ records the details of two new cases. He considers the usual starting-point of the disease to be in the mediastinal glands or in the pericardium. From the former it is probably conveyed by the lymphatics to the deeper layers of the myocardium ; from the latter the invasion is by direct advance from the contiguous pericardium ; the bacilli may also be conveyed by the pulmonary veins. Lancereaux groups the various anatomical forms which we meet with in this disease, as follows : 1. Massive tubercle, in which the nodule varies from the size of a lentil to that of a hen's egg. It is rarely single, more often multiple, and may sometimes be mistaken for an old abscess or gumma. 2. Diffuse tuberculosis ; this is a rarer form, in which we find numerous white or grayish nodules scattered through the myocardium, some being visible beneath the serous lining. 3. Equally rare with the second form is a general tuberculous myocarditis, consisting of a sclerotic process with giant cells and small round cells between the muscle fibres and bands of connective tissue.

¹ *Revue des Maladies de l'Enfance*, June, 1896.

Tuberculosis of the myocardium is essentially a disease of youth, and according to Barre,¹ the majority of cases have occurred earlier than the fifteenth year, although but one or two cases have been seen during infancy. Hand² has added two more cases to our list. The first occurred in a colored child, aged five years, in whom the post-mortem examination revealed a tuberculosis of the lungs, the cerebrum and cerebellum, and the intestines. At the apex of the right ventricle, visible beneath the pericardium, extending through the wall and projecting into the cavity of the right ventricle, was a yellow, cheesy mass the size of a hickory-nut. This seemed to be of equal age with the other advanced tubercular lesions. In the second case, a child of five and a half years, the post-mortem revealed an extensive general tuberculosis, involving the meninges, lungs, liver, spleen, and kidneys. The heart was normal in appearance externally, but on the interventricular septum a small pearly tubercle showed, on microscopic examination, a characteristic aggregation of small round cells. Tuberculosis of the myocardium may exist during life, undiscovered and apparently undiscoverable; there is, apparently, no diagnostic symptom. Labbe's two cases gave absolutely no indication of the cardiac affection, and this appears to be the rule. In other cases the symptoms are those of myocarditis with heart failure, but there is nothing to suggest its tubercular character; in some cases dyspnea, galloping rhythm, tachycardia, bradycardia, arrhythmia, and cyanosis have been observed. These symptoms appear to be the outcome of two factors: on the one hand, there is some degree of destruction of the heart muscle; on the other hand, there is sclerosis of and about the vessels, which, by obliterating their channels, explains the occurrence of dyspneic and synopal seizures analogous in some cases to angina pectoris. Other symptoms depend on the locality of the lesion. (Crawford.³)

Diagnostic Value of Heart Murmurs. Soltmann⁴ discusses the diagnostic value of heart murmurs in childhood. He considers that anemic murmurs are exceedingly rare in the first four years of life, and are rare even up to the eighth year; on the other hand, they appear to be the rule at the time of puberty. In diagnosing an anemic murmur in an older child, however, we should make certain that a positive anemia exists and that acute infectious diseases are absent. Such murmurs should be heard with the greatest intensity at the pulmonary valve; at any rate, a murmur should be more pronounced there than at the apex, and should be purely systolic. The second pulmonary sound must not be accentuated, and the apex of the impulse must be found within the nipple line, and should be without a heaving character. Soltmann refers also to the so-called cardio-pulmonary murmurs, and states

¹ La Semaine Médicale, December 2, 1896.

² Archives of Pediatrics, March, 1898.

³ Practitioner, July, 1897.

⁴ Der Kinderarzt, 1898, ix, 2.

that these also are absent during the first few years of life. These murmurs, like anæmic murmurs, are usually systolic; they are synchronous with the heart action, intermittent, and can be differentiated by the fact that they are increased in forced respiration. Cardiac murmurs noticed during the first few years of life may sometimes be explained by pressure due to enlarged glands, deformities of the thorax, etc. Endocarditic systolic murmurs are rare in children, but when endocarditis is present the murmur is generally its only indication. Other symptoms that we meet with in acute endocarditis of the adult, such as cardiac enlargement, the barking second pulmonary sound, and indications of congestion of the pulmonary vessels and disturbance of compensation, may, in children, be absent.

DISEASES OF THE URINARY SYSTEM.

Composition of Urine. A paper on the composition of the urine of healthy infants and children was read by Churchill at the last meeting of the American Pediatric Society. Comparatively little exhaustive work has been done on this subject, and the physician has hitherto sought in vain for an authoritative physiological standard with which to compare his possible pathological specimens. The investigations of Churchill were made on seventy children, ranging in age from one day to twelve years. Considerable variations in the amount of urine passed at different times was noted. The average daily amount is regarded by Churchill as distinctly less than that recorded by most authors, although special care was taken to obtain a correct total. In children between three and six years it varied from 350 to 400 c.c.; in children from eight to twelve years the variation was from 600 to 800 c.c. The specific gravity of the urine varied from 1018 to 1024, closely resembling, in this respect, adult urine. The amount of urea averaged from 2 to 2.8 per cent. The total amount of urea per kilogramme of body weight is, according to Churchill, slightly higher than the amount generally given for adults, but is distinctly lower than the relative amount for children given by other observers. The chlorides averaged about 11 per cent. up to the age of seven years, after which they declined to about 9 per cent. The phosphates were from 8 per cent. to 11 per cent. from the age of three to that of five years, and fell to between 5 and 7 per cent. in children from six to twelve years of age, the adult range being about 8 per cent. The sulphates averaged 1 per cent. to 1.2 per cent., slightly higher than that of adults, 0.8 being the average of adults. Neither albumin nor sugar was detected in any specimen. The reaction was acid in all cases, although varying in intensity.

Indicanuria. In an interesting paper read before the British Medical Association at its meeting in 1897, Herter draws attention to the result of experiments made by him, which indicate that the amount of indican in the urine depends chiefly upon the activity of the common colon bacillus in the intestine. Carefully prepared cultures of the three species of bacteria normally inhabiting the intestines were introduced with due precautions into the jejunums of dogs. The following results were noticed: The introduction in quantity of cultures of the common colon bacillus into the intestine markedly increased the indican of the urine, and with it the ethereal sulphates. The introduction in the same way of large numbers of the proteus vulgaris increased the ethereal sulphates without increasing the indican perceptibly. The introduction of the lactic-acid bacillus markedly reduced the indican of the urine, together with the ethereal sulphates. He adds that in the human intestine other regular bacterial inhabitants which are indol producers may take a share in the production of indican; but it is probable that this participation is generally unimportant. The increase of indican which occurs in pathological and experimental occlusions of the gut is probably referable to an increased multiplication of the colon bacillus. A similar increase may sometimes be noted in the urine of children suffering from gastro-enteritis when this bacillus is present in increased numbers. Ordinarily various factors operate to prevent the appearance of more than a trace of indican in the urine; one of these is the influence, demonstrable clinically, of a diet containing a large proportion of carbohydrate food, or of a diet of milk. In either case the formation of organic acids is the probable cause of the inhibition of the indol production. We must also remember, in this connection, that if the ingested proteids be in a form which permits their digestive products to be, to a large extent, absorbed from the upper portion of the gut, indol production is likely to be less than in those cases where a considerable amount of proteid derivatives reaches the ileum and colon.

Congenital Abnormalities. In the Lettsomian lectures before the Medical Society of London,¹ Mr. Morgan calls attention to some of the congenital abnormalities met with in the urinary apparatus. In a certain number of cases such abnormalities may exist unrecognized during life, and will only be found accidentally after death; in other cases their presence may complicate a diagnosis and very seriously compromise life itself. A recognized variation from the normal is found when the two kidneys are united across the spine, forming the so-called horseshoe kidney. In such the convexity always faces downward, and lies generally on a lower level than the normal gland. This condition is, however, very rare, and

¹ British Medical Journal, February 12, 1898.

Mr. Morgan states that he has not met with an instance in a child where this condition in itself has been the source of disease or of difficulty in the diagnosis of other affections. The kidney sometimes retains, also without any impairment of efficiency, its lobulate foetal form into adult life. In regard to the absence of one kidney, Mr. Morgan states that it occurs in not more than one out of thirty-five hundred autopsies. Such an absence of the kidney, or its presence in the rudimentary form, may seriously influence our advice as to an operation. In children it is easily possible, when the muscles are relaxed by an anæsthetic, so thoroughly to examine the abdomen that the absence of a kidney from its normal position, or its presence in an unusual one, can hardly fail of detection. With regard to congenital malpositions, Morgan quotes Roberts, who states that in twenty-one cases of this condition the abnormal position was in every instance confined to one kidney. The left was more commonly affected than the right; the most frequent deviation was to find the kidney lying obliquely on the sacro-iliac synchondrosis. In such cases it is of much importance that the condition of the organs of generation should also be carefully examined, since in these cases they frequently exhibit concomitant variations. Curiously enough, abnormalities of the ureters are more frequent than abnormalities in the kidney. Frequently multiple ureters are present, a condition which Shattuck deems a reversion to a lower type. Such multiple ureters do not possess much clinical interest, but if any lesion of the ureters themselves is present hydronephrosis may result. In twenty out of fifty-two cases of this condition, Roberts found a congenital malformation. Hydronephrotic cysts are exceedingly interesting, not only from the pathological but also from the diagnostic point of view. If the condition of hydronephrosis involves both kidneys, death may occur at an early age; but unilateral hydronephrosis may not interfere with life for many years. The swelling which such a condition occasions is to be distinguished from perinephritic abscess, from an ovarian cyst, from hydatids of the kidney, from cysts of the mesentery, and from new-growths. In the diagnosis of congenital hydronephrosis Mr. Morgan recommends that a trial should be made of careful systematic rubbing. Instances are mentioned in which this treatment caused an escape of large quantities of urine with subsidence of the tumor. Where this method of treatment does not relieve the swelling, he recommends frequent tapping. Should suppuration ensue, nephrectomy may be called for.

Movable Kidney. In an interesting paper¹ read at the last meeting of the British Medical Association, Professor Comby calls attention to the condition of movable kidney in children, and states that he was

¹ British Medical Journal, October 15, 1898.

surprised at the relatively large number of cases which, on careful observation, he was able to detect. Of the 18 cases observed by him 2 were aged respectively one month and three months, 6 were between one and ten years, and 10 were above ten years of age. These figures correspond, of course, only to the date of examination and of diagnosis. Sixteen of his patients were girls, 2 were boys. In 14 instances the mobility was associated with dyspepsia and dilatation of the stomach; hereditary syphilis was obvious in 2 cases; chlorosis in 2; hemiterm diarrhea in 1. In nearly every case the affection was latent; in 2 it had been mistaken for chronic appendicitis; only twice had it been found and treated. As regards the etiology, he considers that it was not possible in any of these cases to attribute it to the pressure of corset or belt. Nearly all the patients were dyspeptic and suffered from gastro-intestinal distention, with consequent elongation of the suspensory ligaments and prolapse of the viscera. Many writers regard the condition as of congenital origin. The differing anatomical configuration is the only reason offered to explain why girls should be more liable to suffer from this displacement than boys. The symptoms of the affection are very variable, and do not at any time afford much guide to diagnosis; often the affection is absolutely latent; sometimes there is paroxysmal pain, which may be regarded as due to an appendicitis. These pains become more severe after unusual effort or fatigue. The condition is to be distinguished from coprostasis, appendicitis, cystic or solid tumors of the kidney, perinephritis, stone, etc. When the affection is latent or produces but little disturbance, rest and an abdominal belt may suffice to relieve. A flannel bandage wound round the body several times, supporting the entire abdomen, is an excellent means for immobilization, and it is important to relieve dyspepsia and constipation. If the condition becomes unbearable, an operation should be attempted.

Nephritis in Infancy. During the past few years several important papers have appeared drawing attention to the fact that renal disease is by no means so rare in infancy and early childhood as has been generally supposed. Jacobi,¹ in an interesting paper, states that nephritis is a not infrequent disease of infancy and childhood, and, in his experience, is by no means very rare in the newly born. A predisposition to it exists owing, in the new-born, to the fragility of the blood-vessels and the relative imperviousness of the young renal capillaries compared with the large size of the renal arteries, and, in older infants, to the frequency with which they suffer from gastro-intestinal disorder and consequent liability to absorption of toxins. From an etiological point of view, nephritis in young infants may be: 1. Congestive, arising

¹ New York Medical Journal, January 18, 1896.

from feeble circulation, congenital heart disease, asphyxia, or exposure to low temperatures. 2. Obstructive, caused by rapid physiological decomposition of the blood of the newly born, leading to the formation of hæmatoidin and jaundice; or by the production of methæmoglobin by drugs, such as potassium chlorate; or by the presence of blood in the uriniferous tubules. 3. Irritative, from the presence of uric-acid infarctions or hæmatoidin infarctions, of purpuric or other interstitial hemorrhages, or of microbes and toxins in the numerous eruptive and infectious maladies and in enteritis.

At a recent meeting of the Obstetrical Society of Bordeaux, Audibert¹ presented the results of his investigations concerning *albuminuria in the new-born*. He found that albuminuria was very seldom present in the urine of infants whose mothers had no albuminuria, but with mothers in whom albuminuria, and sometimes eclampsia, was present, albumin was almost always present in varying amounts in the infant's urine.

Acute Nephritis. Dupen² has collected the details of a number of cases of acute nephritis in children. He states that, although the affection is in reality more common than was previously supposed, it is, fortunately, much more hopeful in its prognosis than nephritis occurring in adults. He considers measles a more frequent cause than it is supposed to be by some authors. In other cases irritation of the skin, or absorption of irritating drugs, would appear to be causes of an acute nephritis; burns, too hot baths, fly-blisters, and the application of turpentine and carbolic acid may sometimes give rise to an attack. A case of nephritis due to varicella has been reported by Henoch; post-vaccinal nephritis has also been described. Curley³ reports an acute attack complicating mumps, in a boy four years of age. Dupen also calls attention to the fact that nephritis may be the result of ordinary gastro-intestinal intoxication, more particularly when a condition of dilatation of the stomach exists. The victims of inherited syphilis or of a tuberculous diathesis appear to have a special tendency to develop nephritic inflammation. This is especially the case among the negroes in the Southern States. (Taft.⁴)

Chronic Interstitial Nephritis. Attention has been called by Guthrie⁵ to the fact that chronic interstitial nephritis, generally regarded as essentially a disease of old age, may occasionally exist in children. He has collected the details of seven cases, aged between five and fourteen years, who succumbed to this disease. In all these cases the diagnosis was

¹ Gazette Hebdomadaire de Médecine et de Chirurgie, July 8, 1897.

² British Medical Journal, 1898, No. 1932.

³ Archives of Pediatrics, February, 1898.

⁴ New York Medical News, October 16, 1897.

⁵ Lancet, February 27 and March 13, 1897.

confirmed by post-mortem examination. Bernhard¹ also publishes the details of two cases, one a boy aged fourteen and another a boy aged three, both of whom had a typical granular kidney. The symptoms and physical signs are practically the same as those met with in adults. The patients are generally stunted, undersized, and somewhat wizened, but are shrewd and precocious. Wasting is usually of long standing, and is apt to be regarded as constitutional. Headache, vomiting, especially in the early morning, amaurosis, vertigo, eclampsia, diarrhoea, dyspnoea, thirst, polyuria, and enuresis are among the symptoms most frequently met with. The urine is usually of low specific gravity, and contains a slight, though varying, amount of albumin. Casts are not always seen. They are usually hyaline, but may be granular. Blood-casts may occur in association with an acute exacerbation. Hypertrophy of the heart has been noted in almost every case, and associated with it is a pulse of high tension. Dropsy is almost invariably absent. The wasting is from the first associated with a peculiar dryness and deficient action of the skin, which, later on, becomes inelastic and more or less pigmented. The pigmentation may in some cases strongly resemble that of Addison's disease, but it has not been found to affect the mucous membrane; neither have the sepia spots nor melanosis of old scars, so characteristic of Addison's disease, been observed. It is usually more marked about the abdomen and flanks than elsewhere, and is apparently due to some interference with the functions of the suprarenal bodies, occasioned by the morbid process affecting the adjoining kidneys. Advice is rarely sought for on account of any of the symptoms mentioned, but because such children easily take cold or suffer from headaches with or without attacks of diarrhoea and vomiting. More rarely they are brought to the physician on account of excessive thirst or polyuria; sometimes on account of incontinence of urine. The cases terminate usually in uræmia; in three out of the seven cases mentioned by Guthrie, cerebral hemorrhage occurred. The etiology is obscure: some cases date from an attack of scarlatina, but such history is often absent; a renal calculus or a cystitis may in some cases account for the disease; in others the nephritis appears to be primary, and possibly originates in an attack of acute interstitial nephritis occurring in infancy and unrecognized as such at the time. Syphilis may also be an occasional cause.

Nephritis of Malarial Origin. Kerley² calls attention to nephritis of malarial origin occurring in children, and reports a case occurring in an infant of eighteen months, in which distinct symptoms of nephritis were present, and in which examination of the blood revealed the pres-

¹ Berliner klinische Wochenschrift, March 1, 1897.

² Archives of Pediatrics, October, 1898.

ence of ameboid bodies of the tertian malarial parasite. Under treatment by quinine, the child made a satisfactory recovery.

Incontinence of Urine. Few troubles among children cause more distress and annoyance, both to parents and physicians, than that of enuresis or incontinence of urine, and treatment in a large number of cases is confessedly unsatisfactory. It is to be remembered that incontinence may be only an early symptom of a much more serious disorder, such as diabetes, calculus, hydronephrosis, or nocturnal epilepsy. Rachford¹ states that in a few cases nocturnal incontinence is a symptom of lithæmia (q. v.). Very frequently, however, the disease is of little serious import in itself, and is due in great part to a lack of inhibitory control. In only a few instances can the trouble be ascribed to bad habits or to defective training. Several papers have appeared recently, suggesting new methods of treatment. Coutts² recommends that as a matter of ordinary routine the child should be waked up at stated intervals to micturate, and that the liquids in the child's dietary during the later hours of the day should be restricted. In a few cases, however, when on examination the urine presents a high specific gravity and a high degree of acidity, a trial should be made of allowing the child to drink freely toward the end of the day, in this way rendering the urine less irritating. Belladonna or its alkaloid, atropine, holds deservedly the foremost place in treatment, though it, nevertheless, fails frequently. In cases where the incontinence is nocturnal only, the most efficient plan for the administration of atropine is to give a full dose in the afternoon and evening, the amount of which may be gradually increased. Another drug upon which Coutts places much reliance is lycopodium, which, in his opinion, has a distinctly sedative action on the vesical mucous membrane. He recommends twenty drops of the tincture, to be given three times a day to a child of four or five years. This amount, he says, may be gradually increased until doses of a drachm are given. Lycopodium has been claimed by some to be almost a specific, though it has not proved so in his experience; nevertheless, it has succeeded when other drugs have failed. Bromide of potassium may be of service in those cases in which the act of micturition ensues when waking is imminent or actually takes place. Strychnine he considers useful, especially in combination with iron in those cases in which the general health is at fault. He is not an advocate of circumcision unless there is undue tightness of the prepuce. Should this condition be present the operation is called for quite apart from the question of incontinence. Freyberger³ strongly recommends the fluid extract of *rhus aromatica*. He states that during the past three years he has used it in upward of sixty cases, and considers

¹ Archives of Pediatrics, September, 1897, p. 663.

² Treatment, September 9, 1897.

³ Loc. cit., May 12, 1898.

that he has obtained a cure in 50 per cent. He advises its being given in aromatic elixir, which sufficiently disguises its somewhat astringent taste. In his series of thirty patients the average duration of treatment was forty days. The first signs of improvement occurred in or about the seventh day. A temporary exacerbation was noted in eight cases, lasting from four to six days, after which it ceased abruptly and a cure resulted. For this reason he always tells the parents beforehand that such an increase may possibly occur, but will in all probability be followed by a decided improvement. Prendergast¹ recommends a cold shower-bath or cold douche over the back, every night before putting the little patient to bed. He states that he employed this method of treatment in an orphan asylum on eighty boys, and obtained in the great majority of the cases a complete cure, without employing any drug or paying the slightest attention to any peripheral causes. His method he describes as follows: the child is stripped and placed standing in an empty bath-tub, and a stream of cold water from some vessel with a spout to it like a water-can, is poured over the shoulders and down the back of the subject. In nervous, delicate children one douche may be sufficient; but in sluggish or phlegmatic lads the application must be repeated. After the douche the child is immediately rubbed down, dressed in his night-clothes, and put to bed. Mere sponging has by no means the same effect as the cold douche. This plan of cold douching I have myself employed for several years, and have been much satisfied with the results obtained from its use, although in most instances I have combined it with other modes of treatment.

Vulvo-vaginitis. Conby² states that in his experience vulvo-vaginitis in young girls is generally of a specific character; but almost never of venereal origin, being acquired in an innocent manner from towels, sponges, etc. Marfan³ states that, although a few cases of this affection have been observed during the early days of life, it is usually found in girls from two to seven years of age. Infection may take place either directly from a case of gonorrhoea, by rape or by sleeping in the same bed with a diseased father or brother, or indirectly by infection from a filthy bed, bath, toilet articles, sponges, and sometimes from thermometers. From cases of specific vulvo-vaginitis we should distinguish those cases in which blennorrhoea is present but no gonococci are found. Of these non-specific cases Marfan makes three classes: 1. Those cases where the inflammation is due to saprophytes and bacilli obtained from the feces. This form usually affects the inner and outer folds of the genital organs. 2. A simple purulent vulvitis, due to the microbes of suppura-

¹ New York Medical Journal, July 11, 1896.

² Journal de Médecine de Paris, October 3, 1897.

³ Revue Mensuelle des Maladies de l'Enfance, February, 1897.

tion. 3. An aphthous vulvitis, from which gonococci are also absent. Heiman¹ divides all cases of vulvo-vaginitis into two classes, the catarrhal and the gonorrhœal. The former he subdivides into : 1. Those due to uncleanness, foreign bodies, and trauma. 2. Those due to a specific micro-organism other than the gonococcus. In the gonorrhœal infections he also distinguishes two classes : 1. A pure gonorrhœal type, due only to the gonococcus. 2. A mixed type, in which the gonococcus is associated with other diplococci. Heiman regards Gram's stain as the only crucial staining test for the gonococci, and the only way of differentiating between the gonococci and the diplococci often found in the normal urethra. In another communication, Marfan² refers at length to the complications sometimes arising from this disease. He first distinguishes the complications originating in an extension of the process, such as Bartholinitis, vulvitis phlegmonosa, and blennorrhagia ano-rectalis ; the urethra may frequently be involved but the infection rarely extends to the bladder. Such urethritis may occasion severe burning pain and occasionally prolapse of the urethra. Metritis, salpingitis, oöphoritis, and peritonitis are met with. The latter may run a fatal course or take on a chronic adhesive character. Of the complications which may be met with in distant organs, ophthalmia is the most important. We may also meet with complications due to a general infection. Rheumatism may appear after the ninth day ; it is frequently monarticular, and then generally attacks the knee-joint. The disease usually causes death in the new-born ; gonorrhœal endocarditis and pleuritis may also occur. Gonorrhœa should always be remembered as a possible, although a rare, cause of rheumatism in children.

TREATMENT. In the way of treatment he recommends a solution of potassium permanganate, of the strength at first of 1 in 2000, afterward gradually increased to 1 in 1000 or even stronger, employed in the form of a prolonged irrigation or douche. Such douches are best given through a small, flexible catheter or tube, with the child in the lithotomy position. They should be repeated two or three times a day. Should the disease persist, a change may be made to a solution of corrosive sublimate, 1 in 10,000 ; of resorcin, 1 in 100, or of nitrate of silver, 1 in 3000. Antiseptic solutions should not be too weak, else they take a longer time to effect a cure, which with stronger solutions might be accomplished in a few weeks. Witthauer³ recommends a suppository, 6 cm. in length, and containing 3 per cent. of alumnol, to be introduced into the vagina after careful cleansing of the parts. On the two following days warm sitz-baths should be given,

¹ New York Medical Record, June 22, 1895.

² L'Abeille Médicale, 1897, p. 16.

³ Centralblatt für Kinderheilkunde, 1897, ii. 3.

morning and evening, and the genitals should be thoroughly cleansed. In simple vulvitis, strong injections will do no good; the only treatment required is to bathe the vulva with plain boiled water or a solution of boric acid, to powder the parts, or to smear them with some soothing ointment. In all cases the toilet of the diseased part should be most carefully directed, and the possibility of conveyance of the contagion, either to the eyes or to other children, should be borne in mind. It is very important that the general health of the patient should receive careful attention.

AFFECTIONS OF THE NERVOUS SYSTEM.

Functional Nervous Affections. Saenger,¹ in an article on functional nervous affections as met with in childhood, says that they can be conveniently divided into four classes. In the first he places cases of neurasthenia. The symptoms characteristic of this condition are anæmia, instability of psychical equilibrium, easily produced fatigue, cardiac palpitation, vertigo, precordial distress, increased vasomotor irritability, insomnia, pavor nocturnus, constipation, tremor of the eyelids; occasionally we may meet with true phobias. In the second division are placed cases of hysteria. Among the patients in this class we meet with greater brightness of the intelligence than is usually found among those of the first class. This form of the disease may be characterized by stigmata, as in hysteria in the adult, by monosymptomatic phenomena, blepharospasm, cough, aphonia, constrictures, pseudo-paralysis of the extremities, tremor, anomalies of carriage, hemichorea, and, in rare cases, amaurosis. He makes a third division of those cases characterized by symptoms of neuro-hysteria. This is the form most frequently met with in children, and presents manifold phenomena and interesting, variously combined symptoms. Among those most often encountered are pains in the head and eyes, nervous asthenopia, symptoms of photophobia or contraction of the field of vision, absence of the conjunctival reflex, absence of the pharyngeal reflex, enuresis, somnambulism, and hallucinations. The fourth division includes all those cases in which hereditary neuropathy is present. In such we meet with a distinctly hereditary taint; a history of frequent convulsive seizures during the first years of life, and during childhood conditions resembling tic, in the form of grimacing and choreic movements, disturbances of temper, viciousness, and strong egoistic qualities. These defects are often accompanied by retarded bodily development and imperfectly balanced brain power. Between these typical groups, transitional forms may be found. There is no sharp dividing line between hysteria and neurasthenia. The func-

¹ Münchener medicinische Wochenschrift, 1898, vol. xlv, p. 249.

tional powers of the neurasthenic patient do not possess the ability to recuperate as rapidly as those of the healthy individual; they are easily exhausted and the individual organs appear less enduring and unable to carry out the demands made upon them. The cause of this morbid condition may be found in defective environment, in early mental maturity, in over-pressure of modern education, and in too great strain in early life, depriving the child of a sufficient amount of sleep and relaxation.

TREATMENT. In the treatment of such children we must obtain, as far as practicable, a relief for them from nervous strain in all forms, and afford them every opportunity for recuperation by means of general neurotonic measures, such as abundance of fresh air, carefully directed diet, and regulated exercise. Cold baths and douches, massage, and sometimes electricity, will be of much service, but hypnosis should never be resorted to. Hematinics should be given internally.

Hysteria. Taylor,¹ emphasizing the fact that true hysteria frequently occurs among children, states that it is met with in both boys and girls, though it is twice as common in the latter as in the former. It steadily increases in frequency of occurrence from the third year to the thirteenth, and cases still earlier in life are reported. No age is quite exempt. While an early recognition of any neurosis in childhood is of great importance, this is especially true of hysteria, which, if unchecked, seriously modifies character, growth, and psychic development. The influence of environment and a faulty training, especially of the kind which induces strong emotional exaltation, are powerful predisposing factors. In a few instances hysteria may be acquired by children of unimpeachable parentage and otherwise excellent health. Eshner² considers that hysteria is dependent essentially upon metabolic or nutritional changes in the cellular elements of the central nervous system, in consequence of which there may result alterations in function and changes in relation, whence arise the varied and protean symptoms of the developed disease.

TREATMENT. The treatment of hysteria is always complicated by the fact that the causes which produce it are chiefly associated with the child's environment, so that it is generally necessary to insist upon the complete separation of the child from its parents or previous caretakers for a considerable portion of time. Measures directed to the improvement of the general health have also an important place in treatment. Drugs, except in so far as they accomplish this object, are of little value. A properly qualified nurse, or a wise and patient member of the family who can be taught to exercise the necessary control, is an essential adjunct for success. The hysterical subject is markedly impressionable,

¹ Medical News, January 21, 1898.

² Pediatrics, August 1, 1897.

and, while morbid suggestion from without or from within may produce the malady and encourage its continuance, wise forceful suggestion will frequently effect a cure, especially if accompanied by well-chosen auxiliary measures. Taylor¹ especially recommends repetition of suggestion, with judicious and thorough detail by the nurse or attendant, as of great efficacy. After some improvement takes place the education should be carefully supervised and general measures directed to the removal of functional disturbances, such as hydrotherapy, electricity, and massage, should be employed. For the sensory disturbances the cold douche, or the alternate use of hot and cold water, will be found of much service. Bramwell² relates two cases of hysteria in children, and recommends the following measures of treatment: 1. To convince the patient that she can be cured and will be cured. 2. To remove her from her friends and home surroundings. 3. To place her on ordinary hospital diet; no more milk or fruit. 4. To employ massage and the faradic current. 5. To give medicine merely as a placebo.

Tetany. Tetany in infancy is a condition to which considerable attention has been given during the past few years, but our knowledge of the affection is still very limited. Like epilepsy, it is apparently to be regarded rather as a nosological entity than as a definite disease. In an excellent paper on this subject presented at the last meeting of the American Medical Association by Morse,³ the only definite pathognomonic symptom of tetany is stated to be spontaneous paroxysmal muscular contracture. No case of increased reflex excitability in which this symptom does not occur should be regarded as an example of the disease. Tetany is most frequently met with during infancy; of the American cases collected by Griffith, 66 per cent. were under two years of age. Males are more commonly affected than females. Cassel⁴ states that out of 6822 cases coming under observation in the out-patient service for the treatment of diseases of children in Berlin, tetany was met with in sixty instances; of these thirty-seven were boys and twenty-three were girls. The greatest number of cases occurred during spring and the later months of autumn. The pathology of the disease is still very obscure. Crandall considers the association of tetany with rickets too frequent to be regarded as a mere coincidence. Morse attributes the affection to a toxæmia, the occurrence of which is favored by improper hygienic surroundings, by rickets, by gastro-intestinal disorders, and by certain acute diseases. The most characteristic lesions of the nervous system which have so far been discovered are those in the cells of the anterior horns, especially those in the cervical enlargement. Whether

¹ Loc. cit.

² Edinburgh Medical Journal, February, 1897.

³ Journal of the American Medical Association, November 5, 1898.

⁴ Deutsche medicinische Wochenschrift, January 28, 1897, p. 69.

they are primary here, or secondary to an ascending neuritis, is at present entirely undetermined, and, as they have not been found constantly, further verification is necessary before they can be accepted as the essential lesions of the disease. The disease appears to be comparatively rare in this country. Beside the clonic muscular spasms, which are present in every case, we meet more or less frequently with the following symptoms: Increased electrical excitability of both nerve and muscle to faradism and galvanism, with changes in the qualitative reaction to galvanism. This is known as Erb's symptom, and is seldom absent. Increased mechanical excitability of both nerve and muscle; special examples of this are the occurrence of characteristic contractures as the result of pressure on the large nerve trunks and arteries (Trousseau's symptom), and spasm of the facial muscles when the skin over the trunk of the facial nerve is irritated, or the nerve is struck a sharp blow (Chvostek's symptom). Laryngospasm is occasionally observed. Sensory disturbances, including pain on motion and during spasms, may be frequently inferred; also vasomotor and trophic disturbances, of which the most characteristic are oedema of the wrists and ankles. Fever is rarely present, and intelligence is unimpaired.

TREATMENT. Efforts should be directed to securing for the infant as perfect hygienic conditions as may be practicable. As all the evidence points to the affection being due to a toxic condition, careful attention should be given to the alimentary tract. The use of a purgative, followed by lavage of the stomach and colon, is indicated in the majority of cases. Afterward careful regulation of the diet, and, perhaps, the employment of an intestinal antiseptic, will be of service. Elimination through the kidneys should be favored, and the skin may be stimulated by proper hygienic measures. Symptomatic treatment is important, and consists largely in the avoidance of excitants of spasm and the employment of antispasmodics. Cold, too frequent handling, noise, and excitement are to be avoided. Antispasmodic treatment may be employed locally by the use of such measures as warmth, warm baths, inunctions of oil, and light massage, and constitutionally by the administration of drugs, of which the most useful are the bromides and chloral; opium, belladonna, valerian, and musk may prove of service under certain circumstances.

Meningitis. Although in many particulars our knowledge of the bacteriology of meningitis is still imperfect, recent writers are very emphatic regarding its infectious nature. Clinically we have hitherto recognized three well-marked varieties, septic meningitis, cerebro-spinal meningitis, and tubercular meningitis. In a recent article (Collins¹) the

¹ Twentieth Century Medicine, vol. x. p. 370.

active exciting causes of septic meningitis are classified as follows: 1. Traumatic and infectious. 2. Contiguous and infections. 3. Infectious and metastatic. Under the first of these groups he places all those cases in which the pathogenic bacteria have gained admission to the body through wounds, injuries, or simple abrasions. In the second group are included all those cases which develop in connection with pathogenic disease in adjacent structures and cavities, such as the mastoid, the middle ear, the nose, and even in organs so far removed as the tonsils. In the third division are included those cases of meningitis which are secondary to other infectious diseases, notably pneumonia, typhoid fever, influenza, and dysentery. In the first and second groups the streptococcus, and, more rarely, the pneumococcus or staphylococcus, are the invading forms. In the third group, while the streptococcus may frequently be found, the pneumococcus, staphylococcus, and other pathogenic bacteria are the more important forms. In cerebro-spinal meningitis (*vide* Cerebro-spinal Fever) the organism most frequently met with is the diplococcus intracellularis, which has been found both in epidemic and sporadic cases in pure culture.

Tuberculous meningitis is due primarily to the bacillus of tuberculosis, though pyogenous forms frequently accompany it, a mixed infection thus resulting. Several English writers have very recently called attention to a non-tubercular posterior basic meningitis, which they regard as a distinct form of the disease. At the meeting of the Royal Medical and Chirurgical Society of London, April 13, 1897, Carr read a paper describing the characteristic symptomatology of this form, which had been originally described by Gee and Barlow.¹ All the cases of this disease have occurred in infants under two years of age, who in most instances had previously been in good health. Injury, ear disease, or congenital syphilis cannot, in the greater number of cases, be regarded as an efficient cause, although Holt reports two cases which were distinctly syphilitic. As regards the course of the disease, chronicity appears to be the rule. Still² writes that its special morbid anatomy and the constancy of its clinical and pathological features seem to point to its being a distinct form of meningitis. He divides the cases reported into three groups: 1. Those fatal within six weeks—that is, during the acute or inflammatory stage. 2. Those fatal at the end of three or four months—that is, during the chronic or hydrocephalic stage. 3. Those in which recovery occurs. Corresponding with these variations in the duration of the disease are marked differences in the pathological appearances. In the first form there is much lymph over the base of the brain and on the spinal cord; in the second group he found no trace whatever

¹ St. Bartholomew's Hospital Reports, 1878.

² British Medical Journal, 1898, No. 1872.

of lymph, but only thickening or opacity of the arachnoid, with adhesions, especially between the medulla and the cerebellum. He considers that the early stage of this form of meningitis has not been sufficiently differentiated from the symptoms of a suppurative meningitis, particularly of the common form due to the pneumococcus. At the post-mortem examination it has been labelled sometimes as a healed tuberculous meningitis, and sometimes as a chronic syphilitic change. The author considers that great stress should be laid on the fact that in this simple posterior basic meningitis of infants it is very seldom that any lesions, except such accidental complications as may occur in any prolonged disease, are found in the viscera; whereas in other forms of meningitis, exudation in the meninges is almost invariably secondary to some obvious focus of infection elsewhere. He has never seen a case of posterior basic meningitis in which there was any bone disease in connection with the ear or any evidence whatever of extension of inflammation from the ear, and the same may be said of the nose. In seven out of a series of eight cases he found a diplococcus which, so far as the evidence went, appeared to be the specific cause of the disease. Carr¹ states that the chief diagnostic points between this form and tubercular meningitis are the greater degree of head retraction, the regularity of the pulse, as well as the course and duration of the symptoms.

In the non-tubercular form death is less inevitable than in ordinary tubercular meningitis, and possibly some of the cases of supposed recovery from tubercular meningitis were from this form of the disease. When recovery occurs, however, it is by no means always complete. Hydrocephalus often persists, and there is usually some defect in the subsequent mental development. In the discussion which followed Carr's paper, Barlow² said that he regarded the leading symptoms of this affection to be vomiting, cervical opisthotonos, which was early, constant, and progressive, and a tendency to tonic spasm and rigidity, as opposed to the clonic spasms of tubercular meningitis. As regards the etiology, he did not think that congenital syphilis was of importance, but in some of his cases traumatism seemed to play a part. Many had a history of preceding good health, but he had been struck by the fact that many had a history of catarrh preceding the onset of the illness. Catarrhs in children spread rapidly, and the middle ear in infants is very susceptible to infection. His treatment recently had been based on this view, and he had seen more benefit from early puncture of the tympanic membrane than from any other measure.

Several cases have been reported recently of *recovery from meningitis apparently tuberculous in character*. Acker³ reports two such cases.

¹ Loc. cit.

² Pediatrics, September 1, 1897.

³ Archives of Pediatrics, August, 1897.

The first was that of a colored child, aged three years, rachetic, with fontanelle still open, and ribs beaded. Physical examination of the lungs revealed dulness at both apices with some small mucous rales, heard chiefly on the right side. In addition, the following symptoms were noted: Retracted head, retracted abdomen, screaming spells, with apathy and irregularity of pulse and respiration. He details the history of another case, also a colored child, in which the following symptoms appeared to render the diagnosis of tubercular meningitis a certain one: Race, previous history of tubercular adenitis and keratitis, vomiting, retraction of the head, disease of the lungs, obstinate constipation, apathy, irregularity of pulse and respiration. Had there been a fatal termination in either of these cases, the writer would have recorded the disease as tubercular meningitis. The complete recovery of both renders such a diagnosis a doubtful but not an impossible one. In the discussion which followed, Holt mentioned the case of a child who had generalized tuberculous deposits, involving the lungs, glands, intestines, spleen, and liver; but who yet died of a non-tubercular meningitis. The lesions found post mortem were those of an acute purulent meningitis. If that child had recovered this might have been regarded as a case of tuberculous meningitis with recovery. In another case that he saw some years previously, a child with double hip-joint disease developed meningitis and got well. Six months later the child died from amyloid disease, and the autopsy showed no trace whatever of tuberculosis of the brain. He contends that it is not always safe to draw conclusions from what exists in the other organs of the body, although, if meningitis be present, the existence of tuberculosis elsewhere renders the diagnosis of tuberculous meningitis the probable one.

Netter¹ calls attention to the value of *Kernig's sign* in the diagnosis of meningitis. It is easily elicited in the following manner: The patient is placed in the dorsal decubitus, care being taken that the legs are relaxed and that there is complete extension of the knees. Should meningitis be present, the knees, on the patient being raised to the sitting posture, become more or less flexed, and, despite all efforts, they cannot be completely extended on account of the contracture of the flexor muscles while the patient remains in this posture. In severe cases the knees may remain at an angle of 90 degrees, but in no instance can they be extended beyond an angle of 135 degrees or 140 degrees. Complete extension can be accomplished only when the patient resumes the dorsal position. According to Netter, this symptom is present in 90 per cent. of all cases of meningitis, but has been found absent in all cases of typhoid fever, pneumonia, acute articular rheumatism, etc. He considers

¹ Revue des Maladies de l'Enfance, September, 1898, p. 150.

that the occurrence of this symptom confirms the diagnosis of meningitis when the symptoms are obscure, and suggests a latent meningitis when it is the only symptom present.

Hydrocephalus Treated by Intracranial Drainage. Sutherland and Watson Cheyne,¹ in a paper read at a meeting of the British Medical Association, describe an operation by intracranial drainage for the relief of hydrocephalus. They state that in those cases which come to a necropsy, one frequently finds the membranes of the brain absolutely normal, and no pathological condition present save the enormous dilatation of the ventricles. In the absence of any definite knowledge of the pathological condition, treatment is naturally directed to the relief of the hydrocephalus, which, although possibly secondary, is really the cause of those grave symptoms which lead to a fatal termination. It may be assumed that in chronic hydrocephalus there is a closure of some part of the channel through which the fluid secreted in the lateral ventricles naturally passes to reach the subarachnoid space outside the foramen of Magendie. As a result of such closure the ventricular fluid accumulates, gradually distending the ventricles more and more. According to Leonard Hill, the tension of the cerebro-spinal fluid and that of the cerebral veins is normally the same; with any abnormal increase of tension the cerebro-spinal fluid from the subdural and subarachnoid spaces escapes directly into the veins. Hill states that he has been able to prove experimentally that, on account of this mode of escape, no pathological increase of cerebral tension can be transmitted by the cerebro-spinal fluid. In hydrocephalus, so long as the cerebro-spinal fluid is locked up in the ventricles, not only is it under an abnormal tension, but the tendency will be for it to increase, as there are no channels of escape or absorption; but if an outlet for it were provided into the meningeal spaces, then it would be rapidly absorbed by the veins, until the venous pressure and the cerebro-spinal pressure were again equalized. These writers resolved to test this theory in two cases of hydrocephalus, by making an opening through the cortex cerebri, and introducing into the ventricle a drain which would allow for some time a free passage of fluid from the ventricle into the subdural or subarachnoid space. The first case was that of a male infant six months old, who had suffered from birth with progressive hydrocephalus, for which medical treatment had proved unavailing. The head was much enlarged in all its dimensions, and the other indications of hydrocephalus were well marked; the mental development was practically *nil*; the bones of the cranium were widely separated, the vertex being represented by a large membranous space, measuring nine inches by nine inches at its widest parts. The following

¹ British Medical Journal, October 15, 1898.

operation was performed: A curved incision about one and a half inches long was made over the left lower angle of the anterior fontanelle, and the skin and deeper tissues turned down from off the dura mater. A small incision, about one-quarter inch in length, was then made through this membrane. There was no fluid in the subdural space. As soon as the dura mater was incised a bundle consisting of several strands of fine catgut, about two inches long, was seized with a pair of forceps and pushed downward and slightly backward between the brain and the dura mater for about an inch. The other end of the bundle was grasped with the forceps and pushed through the substance of the brain into the expanded lateral ventricle. Clear fluid escaped immediately. The opening in the dura mater was then completely closed up, and by the fifth day the wound had quite healed. The head had become distinctly smaller in all its dimensions, and there was a complete absence of the tension which had been present before operation. This diminution in the size of the head steadily continued, and in a few weeks the space between the cranial bones was entirely obliterated. At the same time it was noted that the shape of the head became asymmetrical, the left side appearing smaller than the right. There was no improvement in the infant's mental condition. Three months after the operation the child died with symptoms of basilar meningitis.

In another case of advanced hydrocephalus in an infant three months old, an operation similar to the one described was performed on the left side of the head. The disturbance caused by the operation was trifling and transient. The dressings were removed on the sixth day, and the wound was found to be healed. The head was smaller in all its dimensions, the tension of the fontanelle was absent, the spaces between the individual bones were less, but the skull appeared to be asymmetrical, as if the left side had moved backward on the right. Careful examination revealed that, while the drainage of the left ventricle had been as complete as possible, that of the right had come to a stand-still, and the fluid was again increasing. Accordingly, an operation was performed on the right side similar to that performed previously on the left side. Six months after the first operation and a month after the second, the fontanelle measured two inches transversely, and all the bones of the cranium overlapped to a certain extent. There is now a conjunctival reflex, and the child can see; she is gaining weight, and moves the head and limbs more freely; but there are no evidences of mental development.

By these cases it will be seen that the observations of Hill, on the absorption of cerebro-spinal fluid through the meninges under physiological conditions, also hold good in the pathological conditions of hydrocephalus. In no other way can the disappearance of all tension and the

steady diminution in the size of the cranium, following the operation, he explained, as the external wound had healed in a few days, and there was no other mode of escape for the fluid. In those cases of hydrocephalus in which the ventricles were merely tapped through the cranium the fluid reaccumulated rapidly.

In considering the question of operation in chronic hydrocephalus we have to keep in view: 1. The relief of tension. 2. The restoration of cerebral function. The relief of tension is secured by the removal of the fluid as it accumulates in the ventricle. Restoration of cerebral functions is dependent on the development of the brain. If the case is one of congenital hydrocephalus and there have been no signs of mental development before the operation, the prospect for the growth of cerebral tissue becomes less with each month that the infant has lived. If the hydrocephalus has developed in infancy, with failure of mental power, loss of sight and hearing, the time soon comes after which complete recovery cannot be expected.

Lumbar Puncture. Puncture of the subarachnoid space in the lumbar region of the spine has during the past two or three years received considerable attention. It was at first employed by Quincke in 1891, in the hope that he might in this way relieve cerebral tension, especially in hydrocephalus, and obtain some therapeutic advantage, but the results obtained were insignificant and disappointing. In 1895 Furbringer reported eighty-six cases operated upon for diagnostic rather than for therapeutic purposes, with results so striking that the operation at once attracted attention. Since then numerous writers have confirmed its value as a diagnostic measure. Wentworth,¹ in a paper read before the American Pediatric Society, emphasized the following facts: Normal cerebro-spinal fluid contains neither cells nor fibrin, and is perfectly clear. In cases of meningitis the cerebro-spinal fluid is invariably cloudy when withdrawn; the degree of cloudiness is to some extent proportionate to the amount and character of the exudation in the meninges, and is sometimes so slight that close observation is necessary to detect it. This cloudiness is due to cells, the character of which differs with the form of meningitis. In cases of tubercular meningitis the cells were chiefly small round cells with a single nucleus and very little protoplasm, resembling the lymphocytes found in the blood; polynuclear leucocytes were comparatively few. In purulent meningitis the polynuclear leucocytes were very numerous, and the small round cells comparatively few in number. The differential diagnosis between the various kinds of meningitis can thus be made by microscopic examination of the sediment, but more definitely by cultures taken from the fluid. Inoculation experi-

¹ Archives of Pediatrics, August, 1896.

ments afford the surest means of determining the presence of tubercular meningitis. In the normal cerebro-spinal fluid a faint trace of albumin is always present, about one-fiftieth of 1 per cent., or less. In meningitis the amount of albumin is increased, and has been found in from one-thirtieth to one-tenth of 1 per cent.

Monti,¹ of Vienna, in a report presented at the International Congress at Moscow, stated that he has employed lumbar puncture during the past two-and-a-half years for diagnostic as well as for therapeutical purposes. He considers that in tubercular meningitis it has no therapeutic value; in acute cases of epidemic cerebro-spinal meningitis it has distinct diagnostic value in the early, but not in the later, stages of the affection. He also thinks that repeated lumbar punctures in the acute stage appear to have a favorable influence on the course of the disease.

Stadelmann, as the result of his experience, states that neither the specific gravity, which is dependent on the amount of albumin present, nor the amount of sugar contained in the fluid is of diagnostic importance. Positive conclusions can be drawn only from the positive, and never from the negative, results of lumbar puncture. No conclusion can be drawn from the amount of pus present in the fluid. The presence of tubercle bacilli in the fluid is positive proof of tuberculous meningitis. Their absence, however, does not exclude this disease. Cerebro-spinal fluid mixed with blood may be obtained from the accidental admixture of blood from the puncture, or it may be due to the presence of meningeal or ventricular hemorrhage. The former may be excluded when numerous punctures each time bring forth a fluid mixed with the same amount of blood. The operation, although a comparatively simple one, requires the strictest antiseptic precautions on the part of the operator. An antitoxin needle is preferable to the ordinary hypodermic syringe, as it is less liable to break and it has a larger lumen. A syringe is never necessary, but it is well to have a sterile wire to pass through the needle *in situ*, in case the fluid does not run well. The puncture should be made either between the second and third, or between the third and fourth, lumbar vertebrae. The child should be lying on its right side, well bent forward so as to separate the spinous processes. With the left thumb marking the interval, the needle should be entered about one centimetre to the right of the median line, and thrust slightly inward and upward for two or three centimetres. The pain appears to be slight. As a rule, as soon as the needle enters the canal the fluid flows, usually by drops. If the needle does not enter the canal, or if it seems as if the point were not free, the needle should be withdrawn for a short distance and then reintroduced. Any lateral movements

¹ Pediatrics, March 1, 1898.

may give rise to a hemorrhage which may obscure the character of the fluid. Anæsthesia is quite unnecessary.

Abscess of the Brain. Holt,¹ in a very interesting paper, gives a report of five cases of abscess of the brain in infants and a summary of all the previous cases reported in infants and very young children. After five years of age abscess of the brain is not infrequent, and, as a rule, runs a course resembling that seen in older children and in early adult life, but before this age the condition may be judged, from the meagre literature on the subject, to be extremely infrequent. From the symptoms met with in his own cases, and from such as are recorded in his collated cases, Holt deduces the following facts: The development of the symptoms of abscess of the brain in infants is, in about 50 per cent. of the cases, abrupt. Of thirty-two recorded cases, ten commenced with convulsions general or local: in seven there was vomiting, and in only three was fever associated with the vomiting or convulsions; in eleven the onset was very gradual, and the symptoms comparatively latent; in three the disease was entirely latent, and in two no symptoms were noticed until within the twenty-four hours preceding death. During the course of the disease focal symptoms in the majority of cases were entirely wanting, owing to the fact that the parts of the brain in which the great proportion of the abscesses were found are not those which usually give rise to focal lesions. Cranial nerve symptoms were of little value. The general symptoms, while more constant in their appearance, were hardly more definite. The duration of the symptoms was very variable, from twenty-four hours to several months.

The diagnosis under such conditions must always be extremely difficult, as many of the most distinctive symptoms met with in older children, such as headache, tenderness of the skull, visual disturbances, deafness on one side, and the various sensory manifestations, cannot be detected in such young children. Holt says, however, that in the case of any infant with a scar on the scalp, or with a history of injury by some sharp instrument, or a history of a mastoid abscess, or of a long-standing aural discharge followed by hemiplegia, which develops either slowly without fever, or more rapidly with vomiting, fever, convulsions, and other symptoms of acute intracranial inflammation, one can be reasonably sure of the existence of a brain abscess. When the diagnosis lies between meningitis and abscess, he says that if after an injury there is an interval of a few days or weeks before the brain symptoms begin, whether the latter come on abruptly with headache, vomiting, convulsions, and fever, or gradually with paralysis and very little fever, abscess is altogether probable. In the slower and less acute

¹ Archives of Pediatrics, February and March, 1898.

cases the progress is apt to be more irregular than in meningitis, and if paralysis be present it is apt to be more complete and more persistent than in meningitis. In brain tumor the cranial nerve symptoms are more frequent and more prominent; irritative symptoms, such as localized convulsions, are more marked, and pressure symptoms usually less marked, unless the tumor is so situated as to cause distention of the ventricles. Valuable assistance to the diagnosis may sometimes be obtained by lumbar puncture. The discovery of pyogenic organisms in the spinal fluid withdrawn would render abscess or meningitis practically certain, although it might not tell us which was present. Among the conclusions which Holt draws are the following: The principal causes of abscess in the brain in children under five are otitis and traumatism. Abscess rarely follows acute otitis, but often becomes a sequela to neglected cases, and is frequently secondary to abscess in the petrous bone. In cases occurring during infancy without evident cause, the source of inflammation is probably the ear, even though there is no discharge. The development of abscess after injury to the head, without fracture of the skull, is extremely rare; in nearly all of the traumatic cases definite cerebral symptoms show themselves within two weeks after the injury. In cases attributed to blows or falls which have occurred several months previously, there is probably some other cause, such as a latent otitis.

TREATMENT. Holt says operative interference was resorted to in nine of the above cases, of which five recovered. The youngest child successfully operated on was twenty-two months old. He adds that nearly all surgeons agree as to the great shock which attends surgery of the brain in very young children, and this should make one hesitate in urging surgical interference in cases under three years old, unless there are very definite focal symptoms.

Amaurotic Family Idiocy. This is a rare disease of infancy, the symptoms of which commence between the third and fourth months, with muscular enfeeblement and distinct ocular changes, and advance steadily to a fatal termination before the end of the second year of life. It was first described in 1887 by Sachs,¹ and more recently and more fully in 1896 in an article² in which he proposed for the disease the name amaurotic family idiocy. The same affection was described in an exhaustive paper read before the Royal Medical and Chirurgical Society of London by Kingdon and Russell, in January, 1897, under the name of *infantile cerebral degeneration, with symmetrical changes at the macula*. The eye lesion is pathognomonic, consisting in the presence of a whitish-gray patch in the region of the macula lutea which covers an area nearly

¹ Journal of Nervous and Mental Diseases, 1887.

² New York Medical Journal, May 30, 1896.

twice the size of the optic disk ; it is somewhat oval in shape, and slightly raised above the general surface of the retina ; the fovea centralis is seen as a dark-red spot in the centre of this patch. Later on definite optic atrophy occurs with total amaurosis. The general characteristics of the disease are briefly stated in a paper by Koplik.¹ The infant, as a rule, is born in apparent health, and remains so up to the third or fifth month of life. About this time the child appears somewhat stupid, the eyes are rolled vacantly, and there is inability to sit up or to hold the head straight. Spontaneous movements become fewer and fewer ; the muscular weakness over the body and in the extremities gradually increases, and at last becomes a more or less complete diplegia, generally of a spastic, occasionally of a flaccid, nature. Contraction of the field of vision is frequently only surmised after some time has elapsed. At the end of the first year of life, or a little later, these children become totally blind ; afterward a condition of marasmus is gradually developed, to which the children succumb before the end of the second year. The main symptoms are stated by Sachs² to be as follows : 1. Mental impairment, observed during the first few months of life, leading to absolute idiocy. 2. A paresis or paralysis of the greater part of the body, which may be either flaccid or spastic in character, with absent or increased reflexes. 3. A diminution of vision terminating in absolute blindness. 4. Marasmus, with fatal termination, as a rule, at about the age of two years. 5. The occurrence of the affection in several members of the same family. Occasionally we meet with nystagmus, strabismus, and diminution of hearing, but the characteristic ocular finding is never wanting.

As to the etiology, the only definite point noticed in this connection is the fact that all the cases recorded so far were in the offspring of Hebrew parents. The fundamental anatomical change in these cases appear to be a degeneration of the pyramidal cells of the cerebral cortex ; this degeneration is primary in character, and is in no way secondary to any inflammatory or other change. The result of this cortical change may be seen in a widely disseminated degeneration of the fibres of the corona radiata, and of the pyramidal tracts in their whole course through the pons, medulla, and spinal cord. The precise relationship of the ocular changes to those met with in the central nervous system is not very evident. Kingdon and Russell suggest that the macular changes may be due to a degeneration of the ganglion cells of the retina similar to those met with in the pyramidal cells of the cerebral cortex. Jacobi³ reports three additional cases, and states that in his opinion the mere arrest of development in early life cannot cause a progressive change in the nerve

¹ Archives of Pediatrics, October, 1897.

² Loc. cit.

³ Loc. cit., August, 1898.

cells, such as is illustrated by the increase of idiocy, by paralytic, and by the alterations in the retina. He considers it as more probable that the degeneration was originally of an inflammatory character, and possibly the result of some toxic influence.

TREATMENT. Regarding the treatment of this condition, it has been absolutely unsuccessful so far. Kingdon and Russell suggest that when the disease has once shown itself in the family, the mother should be carefully treated throughout the course of any subsequent pregnancy, and the infant should be weaned shortly after birth.

DISEASES OF THE BLOOD.

Anæmias. The question of the classification of the anæmias of infancy has received considerable attention. The physiological presence in early life of cell forms which in adult life are pathological renders a classification based upon adult types extremely difficult. J. L. Morse¹ has suggested a system of classification which, he thinks, will serve for the present as a basis for further study of the subject. The frequency with which splenic enlargement is found in all forms of the blood diseases of childhood has caused him to disregard this symptom and to depend entirely upon the condition of the blood as studied microscopically. Following Monti's method, two main divisions are made of *secondary* and *primary anæmias*. The former is divided into mild and severe forms, each of which may occur with or without leucocytosis; the latter includes pernicious anæmia and leukaemia. This gives six divisions which, with the exception of the primary forms, bear no resemblance in name to the recognized forms of adult life, and are not likely to be confused with the latter. Under the heading of severe secondary anæmia with leucocytosis are grouped all those anomalous cases which do not correspond either with pernicious anæmia or leukaemia. Of such is the anæmia infantum pseudo-leukaemia of von Jaksch, concerning the nature of which there has been so much controversy. The so-called splenic anæmias would, in this classification, come under the heading of severe secondary anæmia without leucocytosis. In the same paper Morse describes a case which he puts, and I think rightly, under the head of severe secondary anæmia with leucocytosis. It presented the following features: In a child of ten months, showing slight indications of rickets, there was moderate enlargement of the lymphatic glands all over the body, slight enlargement of the liver, and considerable enlargement of the spleen. The blood examination revealed 60 per cent. of hæmoglobin, 4,340,000 erythrocytes, and 31,000 leucocytes, a proportion of

¹ Archives of Pediatrics, November, 1898.

1 to 108. Nucleated red cells were numerous, and the white cells showed a relative diminution of the lymphocytes and an increase of the polynuclear forms. The cause of the disease is stated to have been general malnutrition resulting from improper feeding.

Leukæmia. True leukaemia is rare in infancy, and three cases reported during the past year are of interest. In the case of a female child, aged fourteen days, reported by Pollmann,¹ the condition was associated with a patent ductus arteriosus, which gave rise to its characteristic symptoms. The spleen and liver were enormously enlarged, the erythrocytes reduced to 2,500,000, and the leucocytes increased to the proportion of 1 to 8, the increase being almost entirely in the large mononuclear forms. The author concludes that the case was congenital and of the spleno-myelogenous form of leukaemia. A case described by Cassel² was of the same variety and presented enormous enlargement of the spleen. The blood showed 40 per cent. of hæmoglobin, 3,500,000 red and 500,000 white cells, a ratio of 1 to 7. Myelocytes formed 69 per cent. of the leucocytes. The remaining case, reported by Morse,³ was of the lymphatic variety. The patient, a three-year-old child, had but moderate enlargement of the spleen. The blood examination revealed 25 per cent. of hæmoglobin, 2,024,000 red corpuscles, and 87,000 white corpuscles, of which lymphocytes formed 83 per cent. There were no myelocytes. Morse was able to collect from the literature of this subject but seven other cases, of which he furnishes condensed reports. Of these ten (including the three referred to above), four were myelogenous, four lymphatic, and two undetermined.

Treatment of Some Anæmias by Thyroid Extract. Koplik⁴ calls attention to the fact that in cretinism the prolonged use of thyroid preparations is followed by distinct changes in the blood, which, when the correct dosage is attained, results in a permanent increase in the amount of hæmoglobin and in the number of red cells. He details the history of a case of hydraemic anemia with slight enlargement of the thyroid, in which, under the combined use of desiccated thyroids and iron, he obtained results which he was unable to effect by means of iron alone. He says: "I have at present a child aged two years showing slight symptoms of rachitis, but in an extremely anæmic condition. There is a long history of gastro-intestinal disturbance. Under the combined use of thyroids and iron greater improvement has taken place, both in the appearance and in the spirits of the child, than could have been expected under iron alone." He adds: "I have placed these tentative data before you in order to suggest the more general employment

¹ Münchener medicinische Wochenschrift, January 11, 1898.

² Berliner klinische Wochenschrift, January 24, 1898.

³ Archives of Pediatrics, May, 1898.

⁴ Loc. cit., July, 1897.

of thyroids in diseases of the blood and bones, that some definite conclusion may be formulated in regard to the use of this valuable remedy."

CONSTITUTIONAL DISEASES.

Lithæmia. For several years past Rachford has drawn attention to the poisonous effects of an excess of the alloxuric bodies in the system; although many of his investigations have not yet been confirmed by other physiologists, and some of his conclusions are received with much hesitation, nevertheless his papers are always interesting, and his clinical facts have been indorsed by other writers. In a paper read before the American Pediatric Society in 1897, he drew attention to the symptoms which may be induced in children by this condition, which he speaks of as lithæmia. This toxic condition may manifest itself, he states, by attacks of severe gastric pain which are associated with rapid breathing, nausea, vomiting, and fever. The gastric paroxysms may be so severe that all food is rejected for a period of from one to five days. The temperature may range as high as 104° F., but seldom exceeds 102° F. In these attacks the infant may be prostrated to an extreme degree. Occasionally such lithæmic paroxysms may be ushered in by convulsions, which in time may come to be a characteristic symptom of the attack. The paroxysms are self-limited in duration and severity, and are influenced but slightly by medical treatment. Nausea and vomiting pass off almost as quickly as they appear, but sometimes leave behind more or less soreness and gastro-enteric irritation, from which the child only slowly convalesces. The stools following these attacks are frequently very offensive. Between the paroxysms there may be an interval of from one to six months, during which the child may be almost or quite well.

The precocity of lithæmic children is often very noticeable, and is to be distinguished from the precocity of tuberculous children, in that it is commonly associated with good physical development. Such children, if properly restrained during childhood, are capable of the highest intellectual development in after life. Among the rarer symptoms which he attributes to this lithæmic condition are eclampsia, epilepsy, migraine, severe neuralgic attacks, vertigo, aphasia, and sometimes dyspnea. The urine excreted during a lithæmic paroxysm is scant, acid in reaction, highly colored, with an increased specific gravity, and a heavy deposit of urates on standing.

TREATMENT. In the treatment of this affection Rachford emphasizes the importance of a careful dietary. During infancy mother's milk is the ideal food. As the child advances in life cereals may be added, and later on eggs, fish, and poultry. In older children vegetables and

fruit should enter largely into the dietary until they are old enough to lead a very active outdoor life, when butchers' meat in small quantity may be allowed once a day. Exercise in the open air is scarcely less important than diet, and all kinds of outdoor athletic sports should be encouraged. It is a matter of common observation that lithæmic children are averse to outdoor exercise and very fond of indoor intellectual pursuits. At the outset of the treatment a careful search should be made for any reflex factors which may contribute toward precipitating lithæmic paroxysms, eye-strain should be corrected, and pelvic or rectal disease should be treated. The chief indication in the medicinal treatment should be to favor the elimination and promote the oxidation of the alloxuric bodies which are the *materies morbi* of this affection. Constipation should be carefully avoided. Rachford has much faith in the value of the salicylates, and especially of salol, which he recommends to be given in the dose of one grain after each nursing to infants suffering from chronic intestinal fermentation with gastric crises. This should be continued for weeks or months. He also recommends that a small amount of sodium phosphate and lithium benzoate should be dissolved in the milk which these infants drink. A child two years of age, he says, may in this way be given 20 grains of sodium phosphate and 3 grains of lithium benzoate in the twenty-four hours. Should the sodium phosphate not answer the purpose of a laxative, a more powerful saline may be given once a day. Water, either pure or in the form of some mineral water, should be allowed freely. For older children he recommends the following prescription, as a laxative, to be taken every morning :

R.—Sodii salicylatis	.	.	.	.	.	.	.	2 drachms.
Sodii phosphatis (dry)	.	.	.	.	.	.	.	4 "
Sodii sulphatis	"	.	.	.	.	.	.	12 "

From one-half to one teaspoonful to be taken in Seltzer water every morning.

Violent catharsis is not to be desired, but a decided laxative effect must be produced. For those children who can take pills, he recommends a small quantity (gr. ss to j) of potassium permanganate, in a coated pill, to be taken three times a day an hour after food. In migrainous neuralgia unaccompanied by nausea or other gastro-enteric symptoms, this potassium pill is of little value; in this form of affection he has derived much benefit from *cannabis indica* combined with salol.

Chronic Arthritis. During the past two years attention has been directed to some conditions under which chronic arthritis is met with in children. While comparatively frequent as the result of tubercular infection, syphilitic disease, and occasionally of a streptococcic invasion of the joint, chronic arthritis as the result of chronic rheumatism or rheumatic arthritis must be regarded as an extremely rare condition. Still,¹ in a

¹ *Medico-Chirurg. Transac.*, 1897, vol. lxxx. p. 47.

paper on chronic joint disease in children, based on the study of twenty-two cases occurring at the Hospital for Sick Children, Great Ormond Street, describes a disease which he thinks should be differentiated from other forms of arthritis in children. In it we meet with a chronic progressive enlargement of the joints, associated with general enlargement of the glands and enlargement of the spleen. It begins, usually, before the second dentition; in eight of his cases it began before the fourth year of life. The majority of the patients were girls. The onset is usually insidious, the changes in the parts suggesting a general thickening of the tissues around the joint rather than a bony enlargement. There is a marked limitation of movement, but no osteophytic outgrowths are present, even when the disease has persisted for years. The joints first affected are usually the knees, wrists, and those of the cervical spine; more rarely the sterno-clavicular joint or the temporo-maxillary joint; there is no tendency to suppuration or to bony ankylosis. Wasting of the muscles is a striking feature of the disease; the glandular enlargement is general, but affects primarily the glands related to the affected joints; the enlargement is to some extent proportionate to the severity of the disease. There is no tendency to suppuration; valvular disease is not met with, but in three cases the pericardium was found, post mortem, to be adherent. Anaemia of a moderate grade is generally observed; in some instances there is slight continued pyrexia. Sweating is often profuse and bears no relation to the temperature. Examination of the urine shows no noteworthy alteration. The progress of the disease is slow, and in time tends to be stationary. Although bodily development is interfered with, the mental powers are in no way impaired. Still thinks that these cases should be differentiated from others which appear to be identical in their clinical features with the rheumatoid arthritis of adults, and from a rare form of chronic rheumatism of the fibrous type with nodules along the course of the tendons.

Finley¹ records a case of *chronic polyarthritis* in a girl aged eleven years, in whom there was a history of frequent exposure to cold and starvation, but no rheumatic or tubercular family history. The disease commenced in the right ankle four years previous to admission into the hospital; in the following year the right knee also became swollen, later the metacarpo-phalangeal articulations, and shortly afterward the wrist, left ankle, and left knee. For the past two years she had been confined to bed; her legs had gradually drawn up and become contracted, the neck had become painful, and the head twisted to the left. Examination under the Röntgen rays showed that the bones were normal, and the marked thickening around the joint was confined to the soft parts.

¹ Montreal Medical Journal, vol. xxv. p. 94.

Nicholls¹ also describes two additional cases occurring in children, and Koplik² records a case in a child of seven years. Herter³ writes that our knowledge of the etiology of this disease is still very limited; unquestionably certain important similarities exist between the lesions of arthritis deformans and those associated with affections of the posterior nerve roots. The fact that there are muscular atrophies, that the skin is occasionally glossy, and that the muscles are rigid in cases of arthritis deformans, seems to point to its nervous origin, but we are still much in the dark regarding the influence of lesions, in the posterior ganglia or posterior columns of the cord, upon changes in the bones and joints. In some cases the disease has appeared to follow closely upon shock. Personally, Herter is disposed to regard the condition as one in which there are marked nutritive changes acting in connection with some peculiar constitutional condition. Nutritive derangements certainly exist in most cases of arthritis deformans; in his own observations he has found that the total acidity of urine distinctly increased; he has also found evidence of excessive putrefactive changes in the intestine. These changes he does not consider specific.

TREATMENT. Herter believes the diet should be restricted, special attention being paid to the amount of carbohydrates. Beverley Robinson⁴ says that in his opinion the intelligent rational use of baths is productive of the greatest benefit. In a general way he favors the use of the waters from warm sulphur springs. In some cases persistent massage will be found most valuable, but it is not applicable to all cases. The séance should not be too vigorous nor repeated too often. He thinks that when these patients do not do well at the seashore, they do better when they spend the winter in warm climates. In winter he relies chiefly on the continued use of cod-liver oil, not having observed any marked results from iron and arsenic.

The Use of Thyroid Extract in Myxœdema, Dwarfism, and Cretinism. It is now a comparatively old story that myxœdematous symptoms in the child can be made to disappear rapidly by the use of thyroid extract. The effect of this remedy on the tissues, on the growth of the skeleton, and on mental development, is very striking: the infant rapidly becomes reduced in bulk; his muscular and connective tissues become healthier and more compact, and his skin softer and more moist; his brain tissue gradually improves in quality, and his mind works more freely and assumes a healthier attitude. More recently thyroid extract has been used in cases of *dwarfing* of various kinds. Thomson,⁵ in a review,

¹ Montreal Medical Journal, vol. xxv, p. 98.

² Archives of Pediatrics, March, 1896.

³ New York Medical Journal, April 2, 1898, p. 496.

⁴ Loc. cit.

⁵ Pediatrics, March 15, 1897.

quotes several writers who have been studying its effects on the growth of non-cretinous children who had not reached the height proper to their age. Boulenger¹ records nine cases, of which four were idiots or imbeciles suffering also from obesity. All were given large doses of sheep's thyroid (half a lobe every day or every second day); although the effect in diminishing the weight of the obese idiots was only temporary, they all gained in height in a remarkable way. In one the gain amounted to two and two-fifths inches in five months; in others, although the treatment caused increased growth, the result was not so manifest. Schmidt² records four cases who, apart from their backward growth, were normal both in body and mind. The administration of thyroid tabloid was followed by a remarkable increase in height; one case gained nearly four and three-quarters inches in a year.

In an interesting paper, MacPhedran,³ reviewing sporadic cretinism in Ontario, states that it seems immaterial which preparation of thyroid is given: the fresh gland, the desiccated gland, and even the colloid substances have been found almost equally efficacious. It is important, however, that the preparation used should be free from decomposition products, as these probably cause the unpleasant effects occasionally met with during its administration. The dose should be carefully graduated according to the age of the child; we may begin with half a grain of the desiccated gland, two or three times a day, and, if no unpleasant effects result, increase the dose in a week or two to one grain, and later on this may be still further increased if improvement be not satisfactory. If unpleasant effects result, such as fever, rapid pulse, or a feeling of depression, the dose should be lessened or a fresh preparation tried. The necessity for a continuance of the administration of the thyroid is not always absolute. Dr. Bury⁴ reported the case of an infant one year old that had ceased to develop, had become flabby and fat, lost its vivacity, and showed other cretinoid appearances. Small doses of thyroid speedily checked these symptoms, and treatment was discontinued at the end of six months. There was no return of the condition. In more marked cases it may be necessary to give the thyroid once or twice a week to maintain a satisfactory condition. In some cases an intermission of a few weeks may be allowed from time to time without ill effects.

Very recently it has been noted that the influence of the thyroid treatment may be transmitted from the nursing mother *through her milk to her infant*. At a meeting of the Academy of Medicine in Paris, January 12, 1898, Mossa read an account of a woman, the subject of

¹ Thèse de Paris, 1896.

² Jahrbuch für Kinderheilkunde, Band xliii. Heft 2.

³ Canadian Journal of Medicine and Surgery, 1898, vol. iv. p. 275.

⁴ British Medical Journal, September 12, 1896.

goitre accompanied with feeble-mindedness but without symptoms of myxedema, whose infant, three months old and breast-fed, had a large bilobed goitre and was otherwise very puny and sickly, but had no signs of myxedema. The mother was given each day a quantity of thyroid extract corresponding to one and a half grammes of thyroid gland. At the expiration of two months the mother's goitre had diminished in size and the health of the infant had very markedly improved. Shortly afterward the goitre in the infant completely disappeared, while the goitre in the mother continued to decrease.

Thomson¹ calls attention to the fact that in some cases during the thyroid treatment there appears to be a special liability to the production of bony deformities. In many cretins who have passed the age of childhood there is marked lateral curvature; this is apt to be distinctly increased under the stimulus to growth caused by the administration of thyroid substance. Thomson has recorded two cases showing marked deformities of the lower limbs resembling those of rickets. The opinion was expressed that cretins whose bones showed signs of softening should be kept in bed.

Fragility of Bones. Crozer Griffith,² after an extended report of a case of fragilitas ossium occurring in his own practice, gives a summary of sixty-six cases recorded in literature. Fragility of bone may be symptomatic and dependent upon osteomalacia, scurvy, and possibly syphilis, and may occur in connection with several diseases of a nervous character; it may also be due to local causes. In idiopathic fragility heredity is the only etiological factor which appears to be important, inasmuch as direct inheritance or a family predisposition to the disease was shown to exist in eighteen of the sixty-seven cases reported. A considerable number of the cases began in early life. It is an interesting feature of the affection that union of the broken bones in nearly all cases takes place promptly; sometimes the fragments unite so readily that professional advice is not even sought. The only notable symptom of the disorder is the occurrence of numerous fractures from totally insignificant causes. In a few cases pain in connection with the fracture is noted to be slight, but in other cases the accidents are as painful as are fractures in any other condition. The duration of life does not seem to be materially affected by the disease, but the tendency to fracture once established is apt to continue unabated. A certain amount of hope may always be held out to the patient from the fact that a certain number of cases have distinctly outgrown the disposition.

TREATMENT. As we know so little of the cause and nature of this

¹ British Medical Journal, 1896, vol. ii. p. 618.

² Amer. Journ. of the Med. Sciences, vol. cxliii. No. 4.

disease, it is evident that treatment can only be experimental; the maintenance of the best general health, the administration of alteratives of various sorts, and the protection of the limbs against injury, are the most important indications. While guarding against accident care should be taken that the muscles do not waste, and in case of fracture the rapidity with which union between the broken fragments takes place is to be remembered.

Glandular Fever. During the past year or two attention has been called to a disease originally described by Pfeiffer, and termed by him glandular fever. According to Pfeiffer's original description, the disease occurs in children between five and eight years of age. The onset is apparently sudden, with high temperature, loss of appetite, occasional vomiting and constipation, difficulty and pain in swallowing, and pain on moving the head. An examination of the neck shows a number of swollen and painful lymphatic glands. Those lying at the posterior border of the sterno-mastoid and toward the nucha are, according to Pfeiffer, most frequently affected. In mild cases the temperature falls after the first or second day, but in severe cases the symptoms may last eight or ten days, and the glandular swelling may involve both sides of the neck. About the third or fourth day the liver and spleen may be found enlarged, and in some cases severe pain between the umbilicus and the symphysis pubis and a troublesome cough point to the involvement of the mesenteric and retrotracheal glands. Pfeiffer considers this to be an infectious and epidemic disease, but thinks that the infection does not extend beyond the house or family. In a very interesting paper, however, read before the American Pediatric Society,¹ West describes an epidemic of an affection closely resembling Pfeiffer's *Drüsenfieber*, which occurred in Eastern Ohio during the cooler months of 1893, 1894, and 1895. In his cases the glands in front of the sterno-mastoid were chiefly involved. There was some abdominal tenderness, and occasionally the axillary and inguinal glands were also affected. In this epidemic the youngest child to contract the disease was seven months old, and the oldest was thirteen years of age. The glandular swelling persisted for a varying time, from nine to twenty-seven days, averaging sixteen days; the duration of the most active symptoms was from four to seven days. In no case did suppuration of the glands occur. There were no sequelæ, and in no case was there a second attack. There was but one death, and that in a delicate child convalescent from scarlet fever. In all West's cases the most marked feature was the enlargement of the cervical, or, speaking more definitely, the carotid lymphatic glands. As a rule this enlargement began on the left side and reached its full development between the

¹ Archives of Pediatrics, December, 1896.

second and the fourth day. Shortly before its full development on the left side, enlargement and tenderness began on the right side, and followed a similar course. Very rarely was the enlargement confined to one side; in three or four cases there was noticeable enlargement of the post-cervical, axillary, and inguinal glands, but these were never so much enlarged nor so tender as the cervical glands. Abdominal pain and tenderness below the umbilical region were present in three or four cases; the liver generally, and the spleen frequently, showed signs of distinct enlargement. In all cases the urine was scanty and high-colored; respiration was quickened, and in patients old enough, complaint was made of a choking or tight feeling in the throat. There was no ear trouble nor coryza, and no signs on physical examination in any part of the lungs; debility and a weak, rapid pulse were always present, and persisted after other symptoms had passed away. Dawson Williams,¹ commenting on these cases, calls attention to the fact that the most distinctive point of this disease is that the swelling and tenderness of the glands occur without obvious lesion of the pharynx and tonsils, or are altogether disproportionate to any slight pharyngitis which may be present.

TREATMENT. With regard to treatment, little can be said; no drugs appear to have any effect in shortening the course; small doses of calomel during the height of the trouble seemed to lessen somewhat the depression that always followed, but large doses may do harm. In other respects the treatment must necessarily be symptomatic. During convalescence the administration of some preparation of iron is certainly advisable.

INFECTIOUS DISEASES.

Measles. The presence, in measles, of a characteristic eruption on the inside of the lips and on the buccal mucous membrane, which precedes the exanthem by a varying time, was first described by Koplik in December, 1896. He has again drawn attention to it,² and reports sixteen cases in which its detection established the diagnosis. The eruption consists of small, irregular spots of a bright red color, having in their centres a bluish-white speck. These spots may appear as early as three days before the eruption on the skin; with the first appearance of the latter they reach their acme and fade away a day or two later. Slawyk³ detected them in forty-five out of fifty cases seen in Berlin during the winter of 1897-98. We have seen them in two cases, and verified Koplik's contention that strong daylight is necessary to render them visible.

¹ The Lancet, 1897, vol. i. No. 3.

² Medical Record, April 9, 1898.

³ Deutsche med. Wochenschrift, April 28, 1898.

Death in uncomplicated cases of measles is exceedingly rare. Fodger concludes from the bacteriological examination in two cases, which were rapidly fatal and where clinically and anatomically the evidence was negative, that in such cases death is due to sepsis. In 268 cases of measles occurring in the New York Foundling Hospital, reported by Northrup,² the mortality was 13.9 per cent. Broncho-pneumonia was present in one-fifth of the cases, and of these 58 per cent. died. This lesion was found post mortem in all but four of the fatal cases, and it must, therefore, be regarded as the complication most to be feared. In an inquiry into the characteristics of these pneumonias complicating measles, Ivan Houli³ describes a form which, in his opinion, has previously been mistaken for caseous pneumonia, both on account of its protracted course and from the post-mortem appearances in fatal cases. This form is distinguished anatomically by the presence of giant cells without tubercle bacilli. The lesions are of two forms, the one resembling tuberculous nodules, the other caseous pneumonia. Various micro-organisms other than tubercle bacilli were met with. Houli considers that this may be a specific morbillous inflammation.

Focal necrosis of the viscera has been noted in many of the infective diseases. That it is occasionally produced by the toxins of measles has been pointed out by Rowland G. Freeman in a paper read at the meeting of the New York Academy of Medicine on June 2, 1898. In a series of twenty-five autopsies on children who died during the epidemic previously referred to, which occurred in the New York Foundling Hospital, four cases showed marked lesions of this nature in the liver, and in one similar areas were present also in the Malpighian bodies of the spleen.

Six cases of undoubted relapse occurring within twenty days of the first eruption have been noted by Feltz⁴ and Emmet, and the latter has observed 122 instances of distinct second attacks in the same patient. This bears out the generally accepted opinion that measles does not confer the same immunity against second attacks as do the other exanthemata.

TREATMENT. The value of *immunization against diphtheria as a possible complication of measles* was demonstrated by Northrup's experience in this epidemic. In one room where diphtheria had occasionally made its appearance, nine children were not immunized, and on the third day after the appearance of the rash, four of these had a bloody nasal discharge from which cultures of diphtheria were obtained. The five remaining cases were then immunized with 250 units each, and no further

¹ Jahrb. f. Kinderheilkunde, 1897, vol. xlvj. pp. 1 and 2.

² Medical News, 1898, vol. lxxi. No. 28.

³ Wiener klin. Rundschau, 1897, vol. xi. p. 833.

⁴ Gaz. Heb. de Méd., 1896, Nos. 84 and 87.

cases developed. Northrup is in favor of giving an immunizing dose of antitoxin in every case of measles.

Nothing of importance has been added to the accepted *symptomatic method of treatment*. Jurgenson¹ is opposed to antipyretic measures except in case of hyperpyrexia accompanied by coma, delirium, or convulsions, or by an extensive bronchitis. Under such conditions he makes use of cold (under 60° F.) effusions locally, or, in extreme cases, of a bath lasting about five minutes and at a temperature of from 68° to 75° F. Deep inspirations can be induced in cases of suffocative bronchitis by pouring a small stream of very cold water over that part of the occiput which corresponds to the medulla oblongata, or by a cold pack applied to the trunk, leaving the arms free. It is important when making use of the latter procedure to have the feet kept well warmed by hot applications.

Scarlet Fever. Recent researches on the etiology of this disease have not corroborated Doehle's findings of protozoa in the blood. Seitz,² on examining the blood of twelve cases, found it normal in all but one; the blood contained streptococci in this case, which terminated fatally. The presence of streptococci in the blood is to be regarded as due to infection from the throat, and the frequency with which this accidental complication may occur in some epidemics is shown by the fact that Lemoine³ discovered streptococci in pure culture in 93 out of 100 cases examined.

Variations both in extent and site of the characteristic eruption are frequently noted. Lindsay⁴ regards the absence of a rash on the face, when a scarlatiniform eruption is present over the neck and upper part of the chest, as one of the diagnostic points of scarlet fever. Lemoine,⁵ however, states that in 32 out of a series of 200 cases the rash was confined to the face, and in 23 desquamation was limited to this portion of the body. Such an experience must be unique, and if corroborated must add greatly to the difficulties of our diagnosis, owing to the occasional occurrence of erythema of the face in cases of simple sore throat.

Among the rarer sequelæ or complications of scarlet fever must be included paralysis, involving sometimes only one extremity and sometimes the whole body; it is liable to make its appearance both in the earlier and later stages of the disease. An analysis of ten cases collected by Alexieff,⁶ including two of his own, showed that in those cases in which the paralysis occurred in the first week of the disease it was apt to be extensive, involving in most cases both the upper and lower extremi-

¹ Der Kinderarzt, 1898, vol. ix. p. 80.

² Münch. med. Wochenschrift, 1898, vol. xlv. p. 76.

³ Jahrb. f. Kinderheilkunde, B. xiii. H. 3, 4.

⁴ British Med. Journal, February, 1897.

⁵ Loc. cit.

⁶ Journal de Médecine, July 10, 1897.

ties, while in the cases which developed during or after the third week the paralysis was much less severe, and usually resulted in complete recovery. Thrombosis of the middle cerebral artery was found to be the cause in one early case terminating fatally.

TREATMENT. The indiscriminate use of diphtheria antitoxin in the treatment of the anginas of scarlet fever has met with deserved opposition, considering the infrequency with which the Klebs-Loeffler bacillus can be looked upon as the cause. Much, however, can be accomplished by careful cleansing of the pharynx and nasal passages with suitable antiseptic solutions. Traube's method of injecting a 3 per cent. solution of carbolic acid into the tissues of the tonsils and soft palate is spoken of very highly by Seitz.¹ The injections are commenced as soon as enlargement and tenderness of the lymphatic glands of the neck give evidence of septic infection, and are kept up until the temperature remains nearly normal. A special syringe provided with a needle 6 cm. long, and having a small disk soldered on about half a centimetre from the point, is required for the purpose. A daily injection of 1 cm. of the 3 per cent. solution is distributed by a number of punctures over the area involved. The pain produced is of short duration, and a marked improvement in the distress of swallowing is at once experienced, due to the anæsthetic effect of the carbolic acid. It is claimed also that the previously high fever begins to fall after the second injection, and the glandular enlargement to disappear, while a marked improvement is noted in the general condition. The presence of nephritis is held to be no contraindication, some cases having apparently been benefited by it, as evidenced by a diminution in the amount of albumin in the urine. Occasionally the urine shows the color of carbolic-acid poisoning, but this rapidly disappears on discontinuing the injections.

In the treatment of scarlatinal nephritis nothing new has been advanced. F. Detlefsen,² in a review of the subject, enforces the following indications: Rest in bed; quick relief to the engorged kidneys by means of mild diaphoretics and purgatives; proper dieting and unirritating diuretics. The use of baths is of value, preference being given to a warm bath of 98° to 100° F., for fifteen to twenty minutes, once to three times a day. Cold compresses should be applied to the head while the patient is in the bath; afterward he should be wrapped in warm blankets and have friction applied to the skin. If these measures fail to produce a copious perspiration, hot drinks, or to a child of five years $\frac{1}{2}$ of a grain of pilocarpine, or an infusion of 10 grains of jaborandi leaves may be given. Where a bath cannot be used, wrapping the child in a sheet wrung out of hot water and surrounding it with hot bottles will answer

¹ Loc. cit.

² Pediatrics, January 15, 1898.

the same purpose. Flaxseed poultices may be applied with advantage over the kidneys in the interval of the baths. Detlefsen thinks that an absolute milk diet is not to be recommended, on account of its richness in proteids. He prescribes gruel with decoctions of barley, oatmeal, or rice, light farinaceous foods, cooked fruits, and fruit jellies, orange juice, and young vegetables, with only a limited amount of diluted milk. Where there is a deficiency of urine, diuretics are indicated. Two or three wineglasses of Vichy or Wildunger may be given, with plenty of pure spring water, or a lemonade, made by dissolving a drachm of bitartrate of potassium in a pint of boiling water and adding the juice of one lemon, may be substituted. Acetate of potassium, from three to five grains every three hours, is a safe and efficient diuretic. For uræmia a free evacuation of the bowels is procured by jalap or senna or by an enema of equal parts of water and vinegar. Leeches should be applied behind the ears and an ice-bag to the head. In asthenic subjects, to maintain the heart's action, hypodermic injections of caffeine or of tincture of digitalis or of strophanthus, should be given, especially in those cases where œdema of the lungs is detected.

Rubella. The controversy in regard to the identity of rubella is still carried on; many excellent observers still express doubt in the matter, although the arguments in favor of its being a disease, *sui generis*, are, in my opinion, conclusive. Among very recent writers, Blaschko¹ regards it as a mild form of measles. From the fact that he does not consider isolation necessary, and allows the brothers and sisters of the patient to continue at school, we conclude that he does not think that rubella can give rise to measles itself. Much would be done toward settling the dispute if one could point to any one distinctive feature which could be depended upon in the differential diagnosis. Forchheimer considers that the character of the eruption on the mucous membrane of the mouth, called by him the enanthem, is typically distinctive in the three diseases—measles, scarlet fever, and rubella. In a recent article² he describes the character of the enanthem in each disease as follows: In *rubella* the enanthem occurs simultaneously with the exanthem, and is a macular, distinctly rose-red eruption, appearing upon the uvula and the velum of the palate, extending to, but not on to, the hard palate. The spots are not arranged crescentically; they are of the size of large pin-heads, and are very little elevated above the mucous membrane. The enanthem fades away within twenty-four hours; afterward we may occasionally see pigmented deposits of a yellowish or yellowish-brown color, either in the form of spots or streaks. These are to be regarded

¹ Therap. Monatsheft, 1898, vol. xi. p. 659.

² Archives of Pediatrics, October, 1898.

merely as the results of involution, and are not noticeable in the majority of cases. In *scarlet fever* the exanthem appears from twelve to twenty-four hours before the eruption, in the form of the characteristic puncta on the pillars of the fauces, then rapidly spreads over the mouth in the form of a scarlet-red, coalescing eruption, which finally ends in desquamation, producing the strawberry tongue, which lasts well into the second week of the disease. In *measles* the exanthem begins upon the soft palate from thirty-six to forty-eight hours before the exanthem; it appears in the form of purplish or bluish papules arranged crescentically, and gradually extends over the cheeks, and is accompanied by the blue tongue. It is at its maximum at the beginning of the eruption, and may take as long as three or four days to disappear (see Koplik's sign, page 190). Enlargement of the lymphatic glands has long been held a valuable aid in the diagnosis. Stooß¹ in thirty-four cases found the submaxillary glands involved in every instance, the post-cervical and post-auricular frequently, and, in addition, in single instances the axillary and inguinal glands.

Varicella. Concerning varicella there has appeared nothing worthy of note except the reports of two cases of so-called *varicella gangrenosa*.² The lesions in the first case, observed by Lockwood, were more likely due to acute streptococcus or staphylococcus infection than to any peculiar virulence in the toxin of the disease. The second case, reported by L. M. Silver, occurred in a delicate boy aged two years. While the gangrene was limited to the spots of eruption, the constitutional symptoms were most severe, convulsions occurring, in spite of large doses of potassium bromide, on the third and fourth days of the disease. The characteristic eruption appeared on the fourth day, took on a gangrenous character two days later, and spread rapidly, some of the areas measuring two and a half inches in diameter on the second day after their appearance. The eyes became so swollen that the lids could not be opened, and the right carotid gland was enlarged and tender. Bleeding occurred from the gums on the slightest touch, and the stools and vomited matter also contained signs of blood. A small amount of urine, obtained toward the end, showed a condition of acute nephritis. The child died on the eighth day. It is to be regretted that no bacteriological examination of the blood was made in either of these cases. It is well known that the eruption may become hemorrhagic or even gangrenous in debilitated subjects, but here the infection would seem to have been general.

Vaccinia. The bacteriology of vaccinia has received new interest from the able review of the subject by S. Monekton Copeman in the

¹ Correspond. f. Schweizer Aerzte, 1898, vol. xxvii. p. 399.

² Archives of Pediatrics, September, 1898.

Milroy Lectures, on "The Natural History of Vaccinia," and from a paper by A. F. Stanley Kent.¹ Copeman, in 1894, demonstrated an extremely minute bacillus in the early stages of vaccine vesicle. He, however, failed to cultivate it. In 1895 a successful cultivation within an egg showed the same bacillus present after the lapse of a month. From this culture inoculations into a calf produced a lymph which, after passing through a series of calves, was successfully employed for the vaccination of children. More recently still, the same organisms have been cultivated on agar plates and have yielded the same results by inoculation into calves. Kent, by making numerous sections of vaccine vesicles, succeeded in isolating a bacillus which he calls the *diplobacillus vaccinia*, and which corresponds closely to that described by Copeman. It was present soon after inoculation in the cells of the tissues surrounding the vesicle, and persisted up to the twelfth or fourteenth day. Bodies having the appearance of spores were seen, and successful growth was obtained on a medium consisting of glycerin and egg-albumin, the cultures producing typical vaccine vesicles in the calf and in children.

The endeavor to produce vaccine virus free from extraneous micro-organisms has been successfully accomplished by Copeman in glycerinated calf-lymph, which seems likely to supersede all other methods of preservation. The lymph is prepared by the intimate mixture of a certain amount of vesicle pulp with a sterilized 50 per cent. solution of chemically pure glycerin in distilled water. After preservation for some weeks in sealed sterilized glass tubes, the lymph is found to be perfectly active and free not only from the various streptococci and staphylococci usually present, but also from the streptococcus of erysipelas and the bacillus of tuberculosis. The latter, even when artificially produced, rapidly die out, while the possibility of contamination with syphilis is eliminated by the fact that the calf is not subject to this disease. The activity of lymph thus prepared is retained for at least ten months.

Parotitis. In an effort to discover the bacterial origin of parotitis, Michaels,² by catheterization of Steno's duct in one case and in the pus from a parotid abscess in a second, found a diplococcus which he considers may be the specific germ. The organism closely resembled the gonococcus, but was much smaller. It is not stated whether it bears resemblance to any of the organisms already described in connection with this disease.

The publication of a case of paralysis and also one of nephritis following mumps shows that, although usually one of the mildest infections, it is not free from the complications attending the more

¹ Lancet, May 21, 1898.

² Therap. Wochenschrift, 1897, vol. iv. p. 366.

severe infectious diseases. In one of these cases¹ a four-year-old boy developed an acute nephritis on the fifth day of a moderately severe attack of mumps. There were oedema of the face, anuria, and a temperature of 103° F. The first urine passed under appropriate medication contained blood, and on boiling became solid with albumin. The case, which is the second on record, resulted in complete recovery. The other case, one of paralysis following mumps, is reported by L. Revilliod.² The four limbs were affected, but not completely paralyzed; the left facial was also involved, and swallowing was impossible on account of paralysis of the pharynx. The sphincters, special senses, and sensation escaped, and recovery was complete in six weeks. It was impossible to absolutely exclude infantile paralysis and diphtheria.

Pertussis. The bacteriology of whooping-cough has been the subject of considerable study in the past, but in cultures made from the sputum the luxuriant growth of the more common micro-organisms rendered difficult the attempt to isolate any specific germ. Afanassieff, in 1887, found a bacillus which he looked upon as the specific cause, and his results were confirmed in the following year by Szemczehenzof. Other observers, however, failing to find the bacillus described, threw doubt upon its presence, and there the matter rested until Koplik,³ in a study of sixteen cases, succeeded in isolating from thirteen a bacillus seemingly identical with that found by the Russian observers. It is described as a remarkably delicate, short bacillus, thinner than the diphtheria bacillus and not more than half its length, growing well on hydrocele fluid. It is motile, stains with a finely dotted appearance, and is frequently met with in involution forms. Czaplewski and Hensel,⁴ in an examination of forty-four cases, found constantly in the sputum an organism closely resembling that described above, with which they believe it to be identical. On the other hand, Ritter⁵ found the diplococcus *tussis convulsivæ*, previously described by himself, in 147 cases examined: hence the results are somewhat contradictory.

TREATMENT. As in bacteriology, it is impossible to harmonize the results reported by different writers. Sanger's⁶ conclusions seem to us to be justified, that pertussis is a self-limited disease for which there is no specific remedy or class of remedies, and that the chief indications for treatment are to ameliorate the distressing cough, diminish the number and severity of the paroxysms, and check excessive vomiting. Among

¹ Archives of Pediatrics, vol. xv, pp. 2, 108.

² Revue Méd. de la Suisse Romande.

³ British Medical Journal, 1897, 1920.

⁴ Centralblatt für Bakteriologie und Parasitenkunde, December 22, 1897.

⁵ Arch. für Kinderheilkunde, 1898, B. xxi. H. 5, 6.

⁶ Annals of Gynecology and Pediatrics, 1897, vol. x, No. 10.

the drugs claimed as specifics we may mention the following: *Bromoform*, a recently introduced drug, which often affords much relief to the symptoms, but which should be used with caution as it is a dangerous cardiac depressant, and owing to its oily nature is difficult to combine properly in a mixture. In a discussion on Ritter's paper, already alluded to, Rembe¹ referred to a fatal case of poisoning in a child who had taken the ordinary dose. In all, sixteen cases of poisoning from this drug have been reported; the important symptoms were coma and depression of the heart and respiration. *Antipyrine*, another so-called specific, is to be used with care, on account of its tendency to produce cyanosis and a condition of collapse. Those who recommend it, however, claim that it is never necessary to exceed the limits of safety in order to get the best results. Werthheimer² has used it of late years almost entirely, and recommends the following doses: For the first year of life, 0.03 to 0.05 grammes ($\frac{1}{2}$ to 1 grain) two or three times a day, according to the frequency of the paroxysms; from one to two years, 0.10 to 0.15 gramme ($1\frac{1}{2}$ to $2\frac{1}{2}$ grains) as above. For older children, beginning with a daily dose of as many decigrammes as the child numbers years of life ($1\frac{1}{2}$ grains to each year), divided into two or three portions, the amount may be increased one-half in a few days, and, if required, be gradually brought up to twice the amount first administered, though it should never exceed 1.5 grammes (23 grains) in the twenty-four hours. The presence of unhealthy kidneys or of febrile inflammatory infections of the lungs contraindicates its use. Personally, I should hesitate to use this drug for any period of time in larger doses than one-half of those mentioned by this writer. *Tussol* (antipyrine mandilate), a proprietary remedy, is extolled by Rehn,³ and may be given in the following doses: For one year, 0.05 to 0.10 gramme (1 to $1\frac{1}{2}$ grains); two to three years, 0.10 gramme ($1\frac{1}{2}$ grains); three to five years, 0.25 to 0.50 gramme (4 to 8 grains). *Resorcin* is recommended by Rossam⁴ as a local application to the pharynx by means of a small, fine sponge, in solutions of the strength of 2 per cent. in children from one to two years of age, and of 3 per cent. in older children. Applications, he states, should be made every four hours during the day and once or twice during the night. The results of this heroic treatment, as reported by Rossam, are good, not a single death occurring in 290 cases. An improvement was noted in the frequency and violence of the paroxysms in from three to five days, and if the applications were begun early in the disease it was usually unnecessary to continue them longer than ten or twelve days. *Belladonna* is still highly prized by many physicians.

¹ Der Kinderarzt, 1897, vol. viii. p. 49.

² Ibid., vol. viii. p. 193.

³ Jahrb. f. Kinderheilkunde, B. xlii. H. 3, 4.

⁴ Annal. de la Société Méd-Chirur. de Liège, 1897, vol. xxxvi. p. 71.

Jacobi¹ and Dawson Williams² still accord to it the first place. The former insists on the dose being increased until flushing of the face is perceptible within twenty or thirty minutes after each administration. For a child of two years six drops of the tincture are given three times a day, or more frequently if the flushing does not appear, and this dose is to be increased after a few days, all cases demanding at least twice the original dose within twelve days.

Influenza. Attention has been directed of late to the high mortality of influenza in childhood, which in some epidemics is said to reach as high as 30 per cent. Infants at the breast appear to enjoy a certain immunity, but not to the same extent as in other infectious diseases. While presenting in the main the same features as in the adult, the disease in childhood has certain peculiarities. Invasion, as a rule, is slow and insidious; for a few days or even a week the child is languid, and suffers from malaise, with a slight cough and coryza. The cough then becomes marked, and is accompanied by dyspnea and fever of an irregular type. Somnolence is often a prominent symptom; even coma and convulsions may occur in severe cases. During the height of the disease there are congestion of the conjunctiva and excessive lachrymation. The three types, distinguished as the nervous, the catarrhal, and the gastro-intestinal, are all met with, but the last is much less common in children. Of complications, the respiratory is to be feared the most, a comparatively harmless catarrh often developing into a severe broncho-pneumonia. The prognosis is rendered more grave where the nature of the disease has not been recognized and the child has been allowed to run around during the period of invasion. When influenza is epidemic, even slight cases of catarrh of the upper part of the respiratory tract should be treated and carefully watched. Isolation and rest in bed, so far as is practicable, should be maintained from the beginning of the symptoms. The diet should be light, chiefly milk and thin gruels.

TREATMENT. Treatment should be chiefly symptomatic. In many cases the administration of one of the more recently introduced drugs of the coal-tar series appears to afford great relief to the painful symptoms, but caution is required in their use, and it is generally advisable to associate with them caffeine citrate or strychnine as a heart stimulant. Locally much can be done to allay the irritation of the catarrh by forcing the fumes of a 1 or 2 per cent. solution of turpentine or menthol into the nose and pharynx. For this purpose, however, a special form of vaporizer is required. Menthol and eucalyptus with cocaine have been found a valuable combination. Kafemann recommends the following formula for inhalation: Menthol, 1.0; eucalyptol, 2.5; turpentine, 5.0;

¹ Therapeutics of Infancy and Childhood.

² Medical Diseases of Children.

oil of pine, 1.0. Two to four drops are to be inhaled from a V-shaped nose-glass, previously warmed, several times a day.

Typhoid Fever. Against the prevailing belief that typhoid fever in children is a milder disease than in adults, Rocaz¹ is of the opinion that, while the duration of the attacks is shorter, hyperpyrexia is more apt to occur, and the prognosis is grave in children under three years, somewhat less so at four, and favorable only from five upward.

TREATMENT. The necessity for careful treatment, even in mild cases, has been emphasized by Woodward² and Chapin.³ Rest in bed is imperative; it shortens the duration of the disease and lessens its severity. It is, however, sometimes difficult to enforce when the child is not seriously ill. Chapin has seen the fever persist for from eight to twelve weeks from neglect of this part of the treatment. Milk still holds the first place as the standard article of diet, but should be varied from time to time with other light foods. A fresh egg stirred up in a small glass of cool water, to which a few drops of whiskey have been added, forms generally an acceptable mode of supplying nourishment. Constipation is much more common than diarrhoea in the early weeks of the disease, and all writers agree on the value of calomel in combating it and in exercising a favorable influence on the course of the disease. Filaton⁴ orders it in doses of 0.06 gramme (1 grain) every hour for four or six doses, and follows it with a spoonful of castor oil if it is not effectual. Baths are not so often required in young children as in older children and in adults; high temperatures may generally be successfully combated by cold spongings.

Cerebro-spinal Meningitis. The occurrence of sporadic cases of cerebro-spinal meningitis at long intervals, and apparently unconnected in any way with preceding cases, though closely resembling in clinical symptoms and post-mortem appearances the epidemic form, has led many competent observers to hesitate to group this disease among the infectious fevers. More precise methods of examination, however, have shown that there is invariably present in the epidemic cases a micro-organism which has never been demonstrated in the sporadic forms, and it must now be recognized as a specific infectious disease closely resembling a meningitis due to other organisms, but distinct as to etiology, and having a characteristic clinical course. The micro-organism was discovered by Weichselbaum in 1887, and named the *diplococcus intracellularis* from its invariable presence within the cell-bodies, usually the polynuclear leucocytes. Conneliman⁵ has shown that it possesses but feeble vitality

¹ *Annales de la Polyclinique de Bordeaux, Treatment*, 1897.

² *Archives of Pediatrics*, May, 1898.

³ *Post-Graduate*, October, 1897.

⁴ *Revue de Thérap.*, 1897, No. 12.

⁵ *Philadelphia Medical Journal*, 1898, vol. i. p. 21.

and is extremely difficult to cultivate, characteristics which may account for the relatively slight infectiousness of the disease. The mode of infection is not very clear. Personal contact, carriers, and air-infection were all believed to have been demonstrated in an epidemic observed by Peterson.¹ The point of entrance is most probably through the nasal cavities. The disease is most apt to appear during the late winter and spring months, and is more prone to affect older children and young adults, being extremely rare in infants. The incubation period is three or four days. The post-mortem appearances are those of purulent inflammation of the meninges of the brain and spinal cord, with microscopical hemorrhages and small foci of cellular infiltration in the brain and cord itself, varying in degree according to the duration of the disease. The cranial and spinal nerves were swollen, reddened, and embedded in exudation in Councilman's cases. Areas of broncho-pneumonia, sometimes of sufficient extent to render them liable to be mistaken for croupous pneumonia, were the only lesions found in other organs. In his report of the recent epidemic in Boston, Councilman divides the cases into acute, chronic, and intermittent. Among the first were placed cases lasting not longer than fifteen days; in some (the fulminating type) death occurred in forty-eight hours. The chronic cases were characterized by a milder group of symptoms, attended by remissions and exacerbations. The class designated intermittent were so named from the course of the temperature-curve, but in many cases there was no accompanying cessation of symptoms. Considering the notoriously irregular type of temperature met with in the disease, this class is of doubtful utility.

SYMPTOMS. The symptoms vary considerably in different epidemics. Pain in the head is one of the most constant, and may be of agonizing severity. Vomiting, probably of cerebral origin, and delirium are commonly met with, the latter often being intermittent in character, with periods of consciousness lasting for some time. Stiffness of the neck, with retraction of the head, varies in degree, but is almost always present. Paralysis is not common. Affections of the skin were infrequent in the Boston epidemic as compared with previously reported epidemics. Herpes was the most constant; petechiae were present in a few cases only. Affections of the eyes were very common, taking for the most part the form of a neuritis or of paralysis of the ocular muscles.

DIAGNOSIS. The bacteriological examination of the spinal fluid, obtained by lumbar puncture after Quinke's method, is a rapid, safe, and certain method of diagnosis. Councilman found that the organisms varied greatly in numbers, and that when but few were present it was often difficult to obtain cultures. Toward the end of the

¹ Deutsche med. Wochenschrift, 1896, vol. xxii. p. 579.

epidemic, however, by using a large amount of material for his inoculations, positive results were obtained in every case. It was noted also that the number of micro-organisms was directly proportionate to the severity of the symptoms. In those cases in which more than one puncture was made, the number present was found to diminish or increase according as the symptoms had increased or abated.

TREATMENT. With regard to treatment, corrosive sublimate, according to Bela Augyan,¹ injected hypodermatically seems to have a marked effect in mitigating the symptoms, although not sufficient evidence has yet been collected to enable one to speak with certainty. This writer states that after the second or third injection the cerebral symptoms abate, the headache becomes less intense, and the mind clearer; while after the eighth or ninth the temperature falls and consciousness returns. While not shortening the course of the disease to any extent, this treatment apparently hinders the inflammatory process. The application of cold to the head and back, by an ice-bag or by douching, is not to be neglected.

Diphtheria. Now that the profession is almost a unit in regarding the Klebs-Loeffler bacillus as the cause of diphtheria, efforts are being made to differentiate the several forms of the organism and trace the relationship of each to the various clinical types of the disease. That variations in form may correspond to variations in virulence has been several times pointed out. Class² states that his investigations on this subject have led him to believe that the short bacillus produces a toxin of greater virulence than the longer forms, although the local manifestations may not be so extensive; the long bacillus and the streptococcus when found alone produce a mild type, but when associated together they may give rise to the most severe type of the disease, possibly owing to the more intense local inflammation opening up avenues for the more ready absorption of the toxins.

The possibilities of water as a carrier of the disease have been investigated by Demetriades,³ who writes that the bacilli will live in water from twenty-one to thirty-one days, and that, although they lose their virulence rapidly while in the water, it is as rapidly regained when they are placed in a favorable medium. The spread of the disease would seem not to be retarded by the maintenance of proper hygienic and dietetic conditions, Walsh⁴ having shown that diphtheria is more prevalent among the well-to-do; the black race, although less susceptible than the white race, has a higher rate of mortality.

¹ *Memorabilien*, 1898, vol. xli. p. 235.

² *Journal of the American Medical Association*, vol. xxx. p. 13.

³ *Arch. f. Kinderheilkunde*, vols. xx. 5, 6.

⁴ *New York Medical Journal*, June 18, 1898.

Post-mortem examinations of fatal cases have established the fact that, while macroscopically there may be no change in the nervous system, under the microscope it may be seen that the toxin causes an acute degeneration of the peripheral nerves and of the nerve cells in the spinal cord, besides acute parenchymatous and interstitial changes in the muscles, especially those of the heart and smaller arteries.

Recent investigations have shown that but little reliance can be put on the formerly accepted opinion that the situation and character of the membrane are of value in distinguishing between diphtheritic and other forms of membranous angina. A large number of cases have been reported in which a non-membranous sore-throat has, on investigation, revealed the presence of the Klebs-Loeffler bacillus, and has been followed by a characteristic paralysis. Augustus Caillé¹ distinguishes no less than seven different forms of sore-throat as met with in practice. These are : (1) So-called follicular tonsillitis ; (2) primary diphtheria of the tonsils and pharynx ; (3) primary naso-pharyngeal diphtheria ; (4) primary nasal diphtheria, also called membranous rhinitis or diphtheria larvata ; (5) primary laryngeal diphtheria (membranous croup) ; (6) diphtheria without membranes (simulating simple angina) ; (7) secondary diphtheria (following the other infectious diseases). Of the first variety the diagnosis is impossible except by means of a bacteriological examination. Vierordt² describes two clinical forms of this disease. In the one there is a purely tonsillar membranous diphtheria, either as one large whitish deposit covering the whole surface of the tonsil, or as small, separate, islet-like spots, which are wholly or in part situate on the prominent part of the tonsil, of a grayish-white color, and adherent more or less firmly to the underlying tissues. Not infrequently lacunar plugs are connected with the under surface of the deposit. In the other form there is a typical lacunar angina—that is, an angina of the tonsils accompanied by a yellowish-white conglomeration with its seat deep down in the lacune and easily withdrawn or expressed. Under the heading of *larval diphtheria*, Simonin and Benoit³ describe three forms of diphtheritic angina unaccompanied by membrane. These comprise cases in which the bacillus is present without producing any symptoms, convalescents from diphtheria in which the membrane is still present, and cases where the bacillus is found in the mouth of individuals in apparently normal health. The great frequency of these larval forms during an epidemic of diphtheria, the length of time they are capable of imparting infection, and their difficulty of recognition make them important factors

¹ Post-Graduate, 1897, vol. xii, p. 10.

² Berliner klin. Wochenschrift, 1897, xxxiv, p. 153.

³ Revue de Médecine, eighteenth year, No. 1.

in the spread of infection. Bacilli have been shown in some cases to persist in the throat as long as one hundred and twenty days after the original attack of diphtheria. It cannot be too strongly insisted upon that the only certain means of diagnosis is by a bacteriological examination.

A considerable number of cases have been recorded during the past year of diphtheria running a chronic course in spite of antitoxin and local treatment. Such were usually of the nasal class and devoid of general symptoms, but in several instances the disease ran a mild course, although an exudation was also present in the larynx and pharynx. Relapses at varying intervals after an acute attack may prolong the disease indefinitely. Golay¹ describes a case in which three relapses accompanied by fever and the presence of membrane occurred at intervals of twenty-five days, seven and fifteen weeks, respectively. Virulent Klebs-Loeffler bacilli were found in the intervals between the attacks, although each attack was at once controlled by the injection of antitoxin. Still another class of chronic cases are those of so-called rhinitis fibrinosa, which have been studied by A. Hennig,² and shown to be very closely related to the more common pharyngeal and laryngeal forms. Hennig denies that the Klebs-Loeffler bacillus is the cause of diphtheria, and perhaps his evidence on the identity of the nasal bacillus with the other forms is all the more convincing on this account.

Careful observation of the condition of the heart and circulation is of great value in prognosis. Systolic murmurs and irregularities of the pulse are present in about 10 per cent. of all cases. Hibbard³ looks upon tachycardia as of very serious import, death nearly always following a pulse-rate of over 150. Bradycardia of below 60 is an equally bad sign. An analysis by Morse⁴ of 226 fatal cases of diphtheria occurring in the Boston City Hospital since the institution of the antitoxin treatment, shows death to have been due to three principal causes. Sepsis was responsible for 41 per cent., broncho-pneumonia for 30 per cent., and cardiac complications for 20 per cent. Of the latter two-fifths were due to direct poisoning from the diphtheritic toxin, the fatal result having occurred before the seventh day, and, consequently, before the earliest appearance of manifestations of paralysis due to nervous degeneration. Deaths subsequent to the seventh day were due to asphyxia caused by bulbar paralysis or paralysis of the diaphragm. Among the rarer complications we note hemiplegia. Slawyk,⁵ in reporting a case due to

¹ Rev. Méd. de la Suisse Rom., 1897.

² Wiener med. Wochenschrift, 1897, vol. xlvii. p. 1606.

³ Boston Med. and Surg. Journal, March 27 and February 3, 1898.

⁴ Annals of Gynecol. and Pediatrics, 1897, vol. v. p. 7.

⁵ Deutsche med. Wochenschrift, February 10, 1898.

embolism of the Sylvian artery, has collected the records of forty cases in which this complication occurred.

TREATMENT. This question has now practically been narrowed down to the employment of *antitoxin*. There is but one clinic of my note where it has not yet become established, and it has been well said that there is now no remedy which has more testimony in its favor. The value of antitoxin in conferring immunity has already been satisfactorily demonstrated, and the main objection to its use—the fear of untoward effects—has been removed by the evidence accumulated. Its efficacy may be said to be perfect if given twenty-four hours previous to infection and in sufficiently large doses. Two independent observers, Morrill¹ and Slawyk, agree in regarding three weeks as the period of time during which a single dose is efficacious. The length of time during which immunity lasts is, up to a certain limit, directly proportionate to the dose administered; but it is a debatable point whether large injections, or smaller ones at more frequent intervals, are to be preferred. Morrill has shown that while 100 to 250 units will confer immunity for ten days, a larger dose (250 units for a child of two up to 500 units for a child of eight or over) will confer safety for three weeks. Riether,² working among younger children, from a few hours up to three months of age, and using a proportionately larger dose, found that 100 units conferred protection for five or six weeks. He also established the fact that the natural immunity of nursing children was not so great as was formerly thought, thirty-one cases of diphtheria among such having come under his notice within two years. The safety with which antitoxin may be used even at this early age has been well brought out by the same observer. Of 1450 children under three months of age who received the immunizing dose, 240 died from various causes, and in no case was any ill effect attributable to the antitoxin found post mortem. Slight disturbances, usually of a vasomotor character and taking the form of local or general erythema, are sometimes met with as untoward effects of this method of treatment. Joint pains have been noted by Morse³ in 17 out of 1972 children. The larger joints of the lower extremities are usually affected, and swelling, with slight rise in temperature, is present. The cases are to be distinguished from rheumatic arthritis by their shorter duration and their resistance to the salicylates. In a few instances the reaction after the employment of antitoxin is very pronounced, and dangerous symptoms supervene. Apparently such untoward results are not to be explained by any chemical changes in the antitoxin, but are to be attributed to some idiosyncrasy in the individual. In all, five deaths

¹ Boston Med. and Surg. Journal, March 3, 1898.

² Wiener klin. Wochenschrift, 1897, 29.

³ Loc. cit.

occurring within eight minutes after the injection have been reported. An instance of one of these graver cases, happily not fatal, is reported by Rausehenbush.¹ The injection of an immunizing dose of 200 units into his ten-year-old daughter was followed in five minutes by an intensely itching urticarial-like eruption at the seat of injection in the right arm, and by syncope. Ten minutes later the whole body became of a bright scarlet-red color. The child was put to bed after a warm bath, but the collapse continued, the radial pulse being absent in both wrists, and the pupils dilated. Stimulants were freely given with but little immediate response. Two hours after the injection, vomiting of a frothy character set in, but was relieved, and six hours later an itching wheal-like eruption made its appearance on the hands and feet, and swelling of the face and pharynx supervened. The symptoms then slowly abated. The interest in the case lies in the fact that four other members of the household had been injected with an equal dose of serum from the same bottle and had experienced no untoward effects. A somewhat similar but less severe case was noted by Morse² five days after the prophylactic injection of 500 units. There was prostration, vomiting, cedema of the uvula and pharynx, accompanied by a glandular enlargement persisting ten days. The acute symptoms passed off within thirty-six hours. The same patient had had a mild urticaria following an injection of serum two years before. With regard to the dosage of antitoxin the following may be taken as a consensus of the present opinion. The initial dose is the most important, and should never be less than 1000 units. Double this is required in laryngeal and other severe cases. One dose of 2000 units given at the outset is of more value than three or four of 1000 units given at intervals of twelve hours or upward. The dose should be repeated every day until the membrane has disappeared. Strict antiseptic precautions must be taken with the skin, the physician's hands, and the syringe. Now that the bulk of the serum has been much reduced by concentration, any part of the body, where the skin is loose enough to pick up in a fold, will do for the site of the injection. Opinions differ regarding the necessity for *local treatment*. Many physicians still adhere to strong antiseptic solutions and paints applied locally. Many prefer the mild cleansing solutions, but except in those cases in which the antitoxin has not been used sufficiently early to effect a disappearance of membrane, the child's strength is better conserved by absolute rest, and much local treatment should be omitted, especially if, as is usually the case, it has to be given by force. Caillé regards swabbing the throat as harmful, and directs that the solution should be poured into the nose with a spoon or used as a gargle every hour or two both day

¹ Berliner klin. Wochenschrift, 1897, vol. xxxiv. p. 694.

² Loc. cit.

and night in severe cases. *Symptomatic treatment* is to be carried out where indications call for it. High temperature is to be reduced by cold sponging or baths. Heart failure is to be met by rest in bed and stimulants. Schmaltz¹ prefers not to use alcohol except in conditions of threatening collapse, and trusts to an ice-bag placed over the heart as a sedative in cases with frequent, irregular pulse. Recognizing the large percentage of cases in which death is due to heart failure, a roborant diet is looked upon by many as of great importance in keeping up the strength. This principle is carried to an extreme by Kohls, in the Strasburg University Klinik, where a systematic over-feeding with milk, eggs, meat, bread, and alcohol is adopted, and the nourishment is even introduced by a tube if the patient refuses to take what is ordered. In view of the frequency of nephritis, the extra work put upon the kidneys by this method must be regarded as a contraindication to its use. A bland but at the same time highly nutritious diet can be secured, as suggested by Schmaltz and Caillé, by giving milk, eggs, butter, and carbohydrates, with white meats, and avoiding those foods likely to irritate an over-worked kidney.

The question of *intubation* versus *tracheotomy* has received some attention during the year. Even the warmest supporters of intubation admit that there are cases in which tracheotomy is preferable to the simpler operation, but these have become less and less as antitoxin has become more widely used. It seems reasonable to hold that the more severe operation should not be performed until intubation has been tried and found impracticable.

¹ Jahrb. f. Kinderheilkunde, 1897, vol. xlv. p. 119.

PATHOLOGY.

By LUDVIG HEKTOEN, M.D.

THE PATHOLOGY OF INFECTION

The Lodgement of Bacteria. The doctrine of a *locus minoris resistentie*, which has been attacked by some, receives strong support from the work of Meltzer and Cheesman.¹ They found that, while bacteria injected into the normal spleen soon disappear from that organ and from the body generally, the subcutaneous, intravenous, or intrasplenic injection, in cases in which small lesions of various organs have been made by cauterizations or compression, results in the lodgement and multiplication of bacteria in the damaged tissues.

Hofbauer and Czychlarz's² experiments show that the increased localization of microbes in a tissue deprived of nervous influences does not depend on motor or sensory paralysis, but on paralysis of the vaso-constrictors and the resulting hyperemia.

The Role of the Spleen and Lymph-glands in Infections. The rôle of the spleen in the "struggle" of the organism against infection is still obscure; the results of experimental splenectomy, obtained by various investigators, do not agree. Courmont and Duffan's³ recent study of this problem indicates that the spleen does not play the same rôle in all infections; sometimes it may seem useful, at other times it is even harmful, depending upon the infectious agent; its action upon the toxins of a microbe may differ from that upon the microbe itself, and the same animal may react differently to infection soon after splenectomy than later. The probable explanation of these apparently contradictory results is to be sought in the condition of the fluids of the body and the modifications that result therein after removal of the organ.

In experimental infections Bezancon and Labbé⁴ find that the reactive

¹ An Experimental Study of the Direct Inoculation of Bacteria into the Spleen. A Contribution to the Knowledge of the Importance of a Lesion in Animal Tissue for the Lodgement and Multiplication of Bacteria within it. *Trans. of Assoc. of American Phys.*, 1898, vol. xiii, p. 44.

² Ueber die Ursachen des Nerveneinflusses auf die Localisation von pathogenen Mikroorganismen. *Centralbl. f. path. Anat.*, 1898, vol. ix, p. 658.

³ Du rôle de la rate dans les infections. *Arch. de Méd. expériment.*, 1898, vol. x, p. 431.

⁴ Étude sur le mode de réaction et la rôle des ganglions lymphatiques dans les infections expérimentales. *Arch. de Méd. expériment.*, 1898, vol. x.

changes in the lymph-glands play an important rôle against the microbes and their toxins. The glands react, not only by manufacturing the lymphocytes and leucocytes that constitute part of the leucocytosis of infectious diseases, but by becoming the seat of local leucocytic infiltrations at the same time that the endothelial cells, of the reticulum and of the vessels, proliferate and give rise to macrophagocytes; the endothelium of the liver, lungs, spleen, and other organs may present similar changes. It is important to note that toxins may give rise to the same reactive changes as do the bacteria. These authors note that the various toxins may produce more or less specific necrotic lesions. Diphtheria and anthrax toxins cause hyperchromatosis and nuclear fragmentation, pneumococcus toxin leads to vesiculation of the nuclei and the formation of chromatin balls, and the toxin of staphylococcus to indirect division and budding.

The Neutralization of Toxins by the Digestive Fluids, and the Excretory and Bactericidal Functions of the Liver. Powerful toxins, fatal in minimal doses when introduced subcutaneously or intravenously, may be given susceptible animals per os or rectum without effect, even in large quantities. Nencki, Lieber, and Schoumow-Semianowski¹ publish some very interesting studies upon the neutralization of toxins by the digestive juices. *A priori* there are certain facts which point to the lumen of the intestine as the place where the destruction of toxins takes place. Teissier and Gueriard show that the liver has no special influence, because the injection of a minimal fatal dose of diphtheria toxins into the mesenteric vein is fatal. Charrin and Cassin show that injuries of various kinds of the mucous membrane of the ileum are followed by absorption of poison introduced into the digestive tract, because the injuries, by reflex action, stopped the secretion of digestive juices. Contrary to Ransom,² Nencki and his colleagues found that after injection of diphtheria and of tetanus toxin into the stomach, no trace of toxin could be recovered from the feces. They found, further, that the tissues of the stomach and small and large intestine possess a certain but indefinite neutralizing action on toxins. Experiments with sterile and filtered pancreatic juice of dog, rabbit, and guinea-pig show that it possesses a well-marked and constant neutralizing action on the diphtheria toxin, protecting the animals when injected subcutaneously, in small doses, from fatal doses of the toxin injected at the same time; thus, of fourteen guinea-pigs which received subcutaneously ten times the fatal dose of diphtheria toxin mixed with 0.5 c.c. of pancreatic secretion, none died.

¹ Die Entgiftung der Toxine durch die Verdauungssäfte. Centralbl. f. Bakt., 1 Abth., 1898, vol. xxiii, p. 810.

² Das Schicksal des Tetanus Giftes nach seiner intestinalen Einverleibung in den Meerschweinchen Organismus. Deutsche med. Wochenschrift, February 24, 1898.

This action of the pancreatic juice is intensified by subjecting it to a temperature of 38° C. for sixteen to eighteen hours. Sterile gastric secretion of dogs has less destructive action than the pancreatic juice, and is less influenced by temperature; in neither secretion does the reaction play any part in its action on diphtheria toxin. These secretions have a similar action on tetanus toxin, but the gastric secretion is now the more powerful. It was found that a guinea-pig which receives subcutaneously 10,000 times the fatal dose of tetanus toxin with 0.06 c.c. of pancreatic secretion and 0.02 c.c. of bile may live, while one receiving 1000 times the fatal dose and 0.06 c.c. of pancreas secretion and 0.5 c.c. of bile dies in one or two days without symptoms of tetanus, showing that bile succeeds in neutralizing the toxin only in certain proper mixtures with pancreatic juice.

These observations place the action of the digestive fluids in a new light. The various soluble and diffusible poisons produced by the unavoidable intestinal bacteria are probably neutralized by the digestive juices, so that intoxication from the intestines is prevented. While digestive juices have the power of neutralizing toxins they are not immunizing substances; their neutralizing action is unfolded on coming into direct contact with the toxin for a certain time at a suitable temperature.

G. Fütterer¹ publishes certain interesting experiments bearing on the questions of how soon bacteria which enter the portal vein become disseminated throughout the system and when their elimination begins. He injected cultures of the *bacillus prodigiosus* and the *bacillus pyocyaneus* into the portal vein, and inoculated blood from the jugular vein, at regular intervals, upon agar-agar. In this way he found that the bacteria may make their way from the portal vein to the general circulation (jugular vein) in one minute. Further experiments showed that the elimination of micro-organisms entering by the portal vein is inaugurated at once by the kidneys and the liver. Fütterer's previous experiments, showing the rapidity with which bacteria injected into the general circulation appear in the bile, will be recalled. This excretory function of the liver explains the presence of microbes, such as typhoid and colon bacilli, in the bile in the gall-bladder. The relations of bacteria in the bile to the formation of gallstones is discussed on page 245.

Adami's faithful work upon an organism demonstrated by him in cirrhosis of the liver,² has been rewarded with important observations upon the normal bactericidal functions of the liver cells.³ Repeated subculture

¹ *Medicine*, July, 1898.

² Upon the Existence of a Minute Micro-organism in Cases of Cirrhosis of the Liver. *Montreal Medical Journal*, July, 1898.

³ On the Bactericidal Functions of the Liver and the Etiology of Progressive Hepatic Cirrhosis. *British Medical Journal*, 1898, vol. ii. p. 1215.

of the germs isolated from a case of cirrhosis showed that these were, in all likelihood, attenuated forms of the colon bacilli or a variety of the same. Adami then found that a certain number of the diplococcal and other degenerated forms seen in cirrhosis are present in the normal liver, and that the colon bacilli inoculated into the circulation of rabbits are to be found within a few hours in very great numbers within the liver cells, more numerous, in fact, than in the spleen, kidneys, or other organs, and yet a considerable amount of liver juice gives rise to but few colonies, whereas abundant growth is obtained from the heart's blood, spleen, etc. In these early cases Adami found the bile sterile. It would seem clear that the liver cells do not act merely as excretory agents for the bacilli, but have pronounced bactericidal powers.

As regards the relation of the bacilli, normally destroyed by the liver cells, to cirrhosis, Adami is content for the present with emphasizing the remarkable abundance of modified colon bacilli found in the liver as well as in the mesenteric glands in cases of ordinary cirrhosis. The demonstration of additional factors in the effort to prove a relation between the bacteria and the disease will require new experiments.

The Bactericidal Action of Blood Serum and its Relation to the Leucocytes; Phagocytosis. By placing cell-tight parchment packages of anthrax bacilli under the skin of the feet of rabbits, and then producing a passive congestion and œdema, Hamburger¹ demonstrates that the passive congestion favors the destruction of the anthrax virus without phagocytosis. Thiltges² found that the serum of the chicken, which is naturally immune to anthrax bacilli, is bactericidal as regards this organism *in vitro* as well as *in corpore*, and that phagocytosis does not occur in its destruction after subcutaneous injections.

From L. Marchand's³ study of phagocytosis of attenuated and virulent streptococci it is learned that a virulent streptococcus is not taken up by the cells, whereas the attenuated organisms are readily destroyed. Both forms are unaffected by the serum. The phagocytes fail to destroy the virulent form *in vitro* as well as *in viro*, whether dead or alive, after removal of all secretory products by washing, when mixed with attenuated microbes or when placed in fluids containing the secretion of the latter; the attenuated streptococci are taken up by the cells when placed in the secretion of the virulent. For these reasons he concludes that phagocytosis of virulent streptococci fails to take place on account of the physical conditions of the latter.

¹ Ueber den Einfluss venöser Stauung auf die Zerstörung von Milzbrandvirus im Unterhautbindegewebe. Centralbl. f. Bakt., Abth. 1., 1898, xxiv. 345.

² Beitrag zum Studium der Immunität des Huhnes und der Taube gegen den Bacillus des Milzbrandes. Zeitschr. f. Hygiene u. Infektionskr., 1898, xxviii. 188.

³ Arch. de Méd. expériment., 1898, x. 253.

Stokes and Wegefarrth¹ confirm H. F. Mueller's demonstration of fine, dust-like granules in the normal blood. These investigators believe that these granules may come from the protoplasm of the amoeboid leucocytes of human blood as well as of the blood of a number of animals. Filtration of the serum of the guinea-pig and rabbit through porcelain removes its agglutinative and bactericidal powers in regard to certain motile, pathogenic bacteria; on adding leucocytes and granules these powers are restored, indicating that the germicidal substances and granules may be identical. In some cases free granules were seen to gather around the immobilized typhoid bacilli placed in the serum from immunized guinea-pigs. They also state that they were able, in a measure, to substantiate Kanthack and Hardy's observation that anthrax bacilli placed in the frog's lymph sac are first attacked and apparently weakened by the granules set free by leucocytes before phagocytosis takes place. The authors believe that their observations entitle them to advance the theory that the bactericidal power of leucocytes and of serum is to some extent due to the presence of granules elaborated by these cells.

Nicholls² succeeded in staining the bodies above referred to by adding small quantities of Ehrlich's neutrophile stain to 0.5 per cent. salt solution and allowing it to flow under a cover-glass of fresh blood; eosin used in the same way colors the larger granules.

Recent publications by Löwit³ on bactericidal leucocytic materials bring out the following points: Mechanical grinding of leucocytes with powdered glass sets free a microbe-killing substance which withdraws heat. The interpretation that this substance comes from the cells has been questioned by Schattenfroh,⁴ who points out that it might come from the glass, and he found that grinding powdered glass with physiological salt solution brought into solution substances which delayed the growth of typhoid bacilli and streptococci and which possessed some bacteriological properties. Löwit repeated the experiments, and found that the slightly increased alkalinity of the salt solution, after rubbing it with glass, actually hinders the growth of typhoid bacilli upon some, but not on the most favorable, media (Ustehinsky's). Further experiments showed that trituration of lymph-glands liberates cellular bactericidal substances that are not destroyed by heat; these substances are also precipitated by acetic acid and dissolved again in hydrochloric; this precipitate is closely related to nuclein and nucleinic acid. O. Bail⁵ collected leucocytes from a rabbit's blood, washed them with salt solution, and

¹ Johns Hopkins Bulletin, 1898.

² Philadelphia Medical Journal, February 26, 1898.

³ Ueber bactericide Leukocytenstoffe. *Centralbl. f. Bakt., etc., Abth. 1*, 1898, xxiii. 1026.

⁴ Ueber die bakterienfeindliche Eigenschaften der Leukocyten. München, 1897.

⁵ *Centralbl. f. Bakt., etc., Abth. 1*, 1898, vol. xxiii, p. 659.

mixed them with leucocidin derived from the *staphylococcus aureus*. The cells, including the nuclei, are then destroyed and bactericidal substances, which can be tested in various ways, are set free.

H. Van de Velde¹ reviews the present status of the question as to the relation between the bactericidal properties of the serum of the leucocytes, and brings out the fact that the exudates containing living leucocytes possess a greater bactericidal power than the blood-serum of the same or normal animals. This goes to show that leucocytes may secrete substances during the life of the organism, and, further, it has been shown that leucocytes removed from exudates still contain a large quantity of bactericidal substances which can be liberated by destruction of the cells.

Denys and Le Clef have attempted to study, outside of the body, the manner in which the white blood-corpuscles transfer their bactericidal powers to the serum when living, but no satisfactory results have been obtained.

That the increased bactericidal action in hyperleucocytosis, as demonstrated experimentally² and otherwise, depends at least in part on leucolysis, is betokened by the increased elimination of alloxuric bodies and by the appearance of albumoses in the blood under such conditions. There are, therefore, facts which indicate that bactericidal substances are secreted by the leucocytes as well as produced by leucocytic disintegration.

Leucocytes and Antitoxic Action. Loewy and Richter found that hyperleucocytosis, experimentally induced by injections of Pohl's sperminum and by nuclein, appears to have some direct beneficial influence on subsequent diphtheria intoxication due to immediate neutralization of the poison.³

The leucocytosis in experimental diphtheria intoxication, during the process of immunization, and in children during recovery from diphtheria, coupled with its rapid fall in massive intoxication and in fatal human diphtheria, is interpreted by Besredka⁴ as directly curative in its action, and is in full accord with the phagocytic conception which alone can explain the minute details of leucocytic variations in the intoxicated organism.

Cantacuzene,⁵ in his research on the method of destruction of spirilla

¹ Ueber den Gegenwertigen Stand der Frage nach der Beziehungen zwischen den baktericiden Eigenschaften des Serums und der Leucocyten. *Centrabl. f. Bakt., Abth. 1*, 1898, xxiii. 692.

² A. Loewy and P. F. Richter. Zur Biologie der Lenkocyten. *Virchow's Archiv*, 1898, vol. cli. p. 220.

³ *Loc. cit.*

⁴ De la leucocytose dans la diphtérie. *Ann. de l'Institut Pasteur*, 1898, xii. 305.

⁵ *Annales de l'Institut Pasteur*, 1898, xii. 273.

in the organism, finds that the leucocytes are the real agents of feeding in active as well as in passive immunity. In passive immunity the extracellular degeneration of the vibrios, first described by Pfeiffer, is due to the action of ferments liberated by the destruction of leucocytes, for it does not occur when the leucocytes are preserved by means of narcotics; furthermore, the granules which result from the bacterial destruction are capable of multiplying, and the final destruction occurs within the phagocytes. Another evidence that the bactericidal substances in question are produced by leucocytes is shown by the fact that the phenomenon of Pfeiffer cannot be obtained subcutaneously if the leucocytes are prevented from coming in contact with the germs.

In the epidemic septicæmia of geese, described by Gabritschewsky,¹ due to a spirillum different from that of Obermeier, the blood gradually acquires new bactericidal and bacteriolytic powers. These phenomena are most marked in the period of maximum hyperleucocytosis. After recovery, which occurred in only 20 per cent. of the animals, the blood remains bactericidal, but its lysogenic powers diminish or disappear; at all times the bactericidal power of the blood is greater than that of the tissues. Phagocytosis plays a subordinate part in the destruction of the spirilla, and occurs after other factors have reduced their vitality; at all events, the action of the bactericidal and lysogenic substances are certainly of as much importance as phagocytosis, and whether these substances are produced by leucocytes only or by other cells as well is, indeed, a difficult question to decide. The serum of immunized horses in doses of 2 c.c. protects geese against fatal quantities of spirilla injected subcutaneously, provided the serum be given before the spirilla enter the blood of the animal.

The study of venoms has also thrown light upon the interactions of cells and toxins. The rapid and precise action of venoms is of great advantage in the experiments, and greatly reduces the chances of error. The researches of Calmette² and others have shown that there is a striking analogy in the action of the venoms of reptiles in various parts of the world, and that an animal immunized artificially against a venom of marked activity becomes immune to all less active venoms; further, that the serum of vaccinated horses possesses a marked preventive and curative power against all snake poisons.

The studies of Fraser and Phisalì show that bile destroys the toxicity of venoms *in vitro*, even after the bile has been heated. Calmette made further experiments in this direction and found that bile, or some of its

¹ Beiträge zur Pathologie und Serotherapie der Spirochætien-infection. Centrallbl. f. Bakteriologie, Abth. 1, 1898, xxiii. 365.

² Sur le mécanisme de l'immunisation contre les venins. Annales de l'Institut Pasteur, 1898, xii. 343.

principal constituents, injected some time before or after the venom, has no preventive effect. Cholesterin, as well as other substances, such as fresh bouillon, injected from two to four hours before the venom, may postpone the fatal result for from one to five days. Bile has, therefore, no specific antivenomous action; the apparent slight preventive action referred to is explained as the result of a transitory stimulation of the leucocytes. Venom intoxication is always accompanied by hyperleucocytosis, and venom mixed with leucocytic exudation is partly or wholly neutralized. The rôle of the leucocytes in snake poisoning is of great importance; nerve tissues have no such effect on venom as Wassermann and Takaki show them to exercise on tetanus toxin. Calmette also shows that poisons which act directly upon nerve cells and, in general, lower their resistance, do not destroy thereby the immunity of animals passively immunized to venoms.

On the other hand, Pfeiffer and Marx¹ show that after a single subcutaneous injection of dead cultures of cholera germs into healthy rabbits a specific bactericidal protective substance forms in the blood in very strong concentration. This first appears on the third day after the injection and increases rapidly to the fifth and sixth days. Similar changes occur in the blood after the injection of dead cultures of typhoid bacilli, but the maximum degree of activity is reached after a longer time. The rabbit is, therefore, a good animal in which to look for the sources of specific protective bactericidal bodies.

Investigations were then made to learn if the antibodies are formed in the circulating blood itself, and, if so, whether by the leucocytes or by the plasma. Aleuronat was injected into the pleura of freshly immunized rabbits, and the exudate, rich in leucocytes, was filtrated and compared with the blood, with the result that it contained less antibodies than the serum. Fresh blood was centrifugalized and the part composed of leucocytes obtained, but this was not richer in antibodies than clear serum. Hence, the authors conclude that the leucocytes of the blood cannot be the place where protective material is formed.

The examination of the organs at the beginning of immunization for antibodies, by grinding them up with glass and making emulsions with fixed quantities of bouillon, showed that all organs excepting the bone-marrow, lymph-glands, and especially the spleen, were poorer in antibodies than was the blood. In two cases (four days after injection) the immunizing value of the spleen was four times higher than that of the blood-serum, and in these cases the spleen contained agglutinating substances in greater concentration than did the serum.

¹ Untersuchungen über die Bildungsstätte der Choleraantikörper. Deutsche med. Wochenschrift, 1898, 47.

The anticholera substances in the spleen readily pass into a watery solution, and the centrifugalized extract is also more active than the serum. These facts indicate that the blood-forming organs are the place of origin of the specific immunizing materials in cholera, though there may be only an accumulation in these organs.

In animals injected subcutaneously with cholera serum of high value the spleen was less antitoxic than the blood, and this agrees with the results of Behring and his co-laborers, who found that in passively immunized animals the antitoxin was found only in the bloodvessels.

Stephens and Myers¹ found that antivenomous serum neutralizes the inhibition or delay of the clotting of blood caused by the cobra venom *in vitro*; further, that the same dose necessary for neutralization of venom *in vitro* is also the quantity required for neutralization of venom in the bodies of guinea-pigs. The neutralization of a toxin by an antitoxin *in vitro* is certainly not vital or cellular, but must be chemical. Hence, these experiments support Ehrlich's chemical theory that the antitoxin renders the toxin harmless by combining with it.

Martin and Cherry² found that the antagonism between the diphtheria toxin and snake venom and their respective antitoxins is due to a direct chemical action between them, as becomes apparent if a mixture of the proper neutralizing quantities is left at 30° C. for two hours. Similar experiments by Calmette and others resulted in the opposite conclusion, because the element of time as a factor in the reaction was entirely neglected.

Later Martin³ brings out further evidence of the chemical nature of this antagonism between toxin and antitoxin. He shows that about the same quantity of antivenom required to neutralize venom *in vitro* is also able to do so when the former is injected into the blood and the latter subcutaneously, but that about ten to twenty times this amount is necessary when both are placed under the skin of different parts of the body. In the latter instance the explanation given of the large quantity of antivenom required is that this is absorbed much more slowly from the subcutaneous spaces than the venom. When the antivenom is injected into the blood it is in a position readily to neutralize the toxin as it is absorbed, as would be expected if the antagonism is chemical.

Further important observations bearing on the problems of cellular relations to toxins have been made, especially by the investigators who have worked on tetanus.

¹ The Action of Cobra Poison on the Blood. *Journal of Pathology and Bacteriology*, 1898, vol. v, p. 279.

² Proceedings of the Royal Society, 1898, vol. lxiii, No. 400.

³ *Loc. cit.*, vol. lxiv, No. 403.

The Influence of the Organism upon Toxins as Revealed by the Study of Tetanus Toxin. Wassermann and Takaki¹ made an emulsion of the brain and the cord of the guinea-pig and other animals in normal solution, and added much more than the ordinary fatal quantity of tetanus toxin; this mixture had no effect when inoculated, and hence they conclude, in accordance with Ehrlich's chemical theory of immunity, that the central nervous tissues contain antitetanic substances.

The affinity between nerve cells and tetanus toxin is also shown in the following experiment by Knorr:² An emulsion of the brain substance of a guinea-pig and tetanus toxin is centrifugalized, when two layers form; the upper, an opaque fluid, does not contain any toxin, all of which has united with the lower layer, composed of solid nerve tissue.

Marie³ then demonstrated that the apparent antitetanic action of the nervous tissues is dependent upon the power of the nerve cells to fix and hold the toxin when the two are mixed together; if the brain substance be injected separately, before or after the toxin, then the nervous tissue has no protective action.

Blumenthal⁴ assumes that the tetanus toxin must enter into a combination of some kind with cells, especially of the spinal cord, before symptoms are produced. The toxin is brought to the organs by the blood, unites with the substances of unknown nature found in the cells, and the resulting compound constitutes the real tetanus-producing material in the animal experimented upon, but is not pathogenic for other animals. Antitoxin can only act upon the toxin in the blood, it has no power over the toxin already fixed in the cells; thus is explained the frequent failures observed in the use of antitoxin in actual practice.

Conclusions of similar import are reached by Asakawa⁵ in a study on the basis of the natural immunity of fowls against tetanus. Tetanus toxin may exist in the chicken's blood for six days after injection without undergoing any changes, and the animals do not become intoxicated, even after reduction of the normal temperature. The brain and the spinal cord contain no toxin after such experiments (the latter may contain very small quantities), whereas the blood and other organs contain the substance in unaltered form. The emulsions of the central nervous substance of guinea-pigs and rabbits, with toxins, destroy or neutralize the

¹ Ueber tetanusantitoxinische Wirkung des normalen Centralnervensystems. Berl. klin. Wochenschr., 1898, No. 1.

² Münch. med. Wochenschrift, 1892, No. 12.

³ Recherches sur les propriétés antitétaniques des centres nerveux de l'animal. Annales de l'Institut Pasteur, 1898, vol. xii, p. 91.

⁴ Ueber die Veränderungen des Tetanusgiftes im Tierkörper und seine Beziehung zum Antitoxin. Deutsche med. Wochenschrift, 1898, No. 12.

⁵ Die Basis der Natürlichen Immunität des Huhns gegen Tetanus. Centr. f. Bakt., Abth. I, 1898, vol. xxiv, p. 166.

latter. This antitoxic peculiarity of the central nervous tissues depends upon the presence of an unknown intracellular chemical substance, "X," which unites with the toxin and forms a new intracellular substance, "T + X" (this emulsion is not protective), which is probably the pathogenic factor of tetanus. In the chicken there is not enough "X" to produce sufficient "T + X" to cause tetanus. Although it seems to possess antitoxic properties when mixed with "T" in the glass, yet the "X" need not be the natural destructive mechanism of the body, but more likely a necessary factor in the pathogenesis.

The conclusions of Blumenthal and Asakawa are greatly strengthened by the almost simultaneous publications of Roux and Borrel,¹ who make use of the affinity of tetanus toxin for nerve cells in a very ingenious way. By injecting toxin into the brain of the rabbit, guinea-pig, or rat, they produce a peculiar tetanus of a distinctly cerebral type, due to the immediate fixation of the toxin by the living nerve cells. Convulsions, motor paresis, peculiar psychic and other symptoms develop, depending somewhat upon the part of the brain experimented upon. This novel method of studying the functions of various regions of the brain may, perhaps, be found useful from a physiological stand-point. By varying the amount injected, various forms of cerebral tetanus are produced, some rapidly and some more slowly fatal, while the affection produced by minute doses may be followed by recovery. Animals possessed of passive immunity, their blood containing antitoxins, are, nevertheless, susceptible to cerebral tetanus after direct intracerebral injection of toxin, provided mechanical extravasation of blood does not occur during the puncture of the brain. Even the nerve cells of actively immune animals are sensitive to the toxin, and it does not seem possible that such cells could ever produce an antitoxin, as claimed by Wassermann; on the other hand, it would appear as if the nerve cells did not come in contact with antitoxins during immunization. Intracerebral injection of anti-tetanic serum has, however, a much prompter effect in animals with tetanus than when injected subcutaneously in much larger quantities—a fact that may be found of value in the antitoxin treatment of human tetanus; antitoxin, as ordinarily used, may destroy the toxin still in the blood, but fails to reach that which is fixed by the cells of the brain or spinal cord.

Roux and Borrel also find that intracerebral injections of diphtheria toxins are followed by rapidly fatal symptoms in susceptible as well as in immunized and naturally immune animals (rat).

In the immunized animals the characteristic lesions of diphtheria intoxication are not found under these circumstances, because they are pro-

¹ *Tétanos cérébral et immunité contre le tétanos. Annales de l'Institut Pasteur*, 1898, No. 4.

ected by the antitoxin which fails to reach the nerve cells, and which, evidently, have less affinity for the antitoxin than for the toxin. In the naturally immune animal the immunity to the toxin as ordinarily introduced does not depend upon resistance of the nerve cells but upon other properties of the body which prevent the toxins from reaching the brain. They also found the nerve cells of the rabbit to be sensitive to morphine, to which this animal is commonly regarded as immune.

All these highly interesting observations would tend to show that acquired as well as natural immunity to certain poisons does not in the least depend upon insusceptibility of the nerve cells. The toxins are retained by other cells, which also, perhaps, manufacture antitoxins, and these cells, Roux and Borrel are inclined to believe, are the phagocytic cells which destroy not only bacteria but also bacterial toxins.

Metschnikoff¹ shows that the apparently antitetanic power of the central nervous tissues, demonstrated by Wassermann and Takaki, is most characteristic (*in vitro*) of the animals most sensitive to tetanus toxin, less markedly so of refractory animals, and absent in the brain of the frog. Hence this power, present only in the nervous tissues of mammals, cannot be used to explain natural immunity, which Metschnikoff claims does not depend upon antitoxins. Further experiments with the tissues of animals immunized against tetanus prove that the nervous tissues are not the seat of either the production or the deposition of the antitoxin, and that toxin mixed with brain tissue is not destroyed by the latter but by the action of the leucocytes which accumulate around the injected material and absorb the toxin. The phagocytes react not only against microbes but also against toxins.

In a later article Metschnikoff² further reports that a mixture of brain substance (of rabbit or guinea-pig) with tetanus toxin injected into the peritoneum of guinea-pigs is slowly absorbed by leucocytic phagocytes, especially the large mononuclear cells. The discovery of Wassermann, instead of proving the existence of a cerebral antitoxin, is, on the other hand, a demonstration of the action of phagocytes against toxins.

In connection with this subject he calls attention to the leucocytosis which follows the injection of a not too excessive quantity of tetanus toxin in susceptible animals, and also to the taking up and modification of arsenic by the leucocytes of animals accustomed to its action; in such animals the injections of arsenic cause a marked hyperleucocytosis.

The Theory of Immunity. Metschnikoff summarizes a masterly review of the doctrines of immunity³ somewhat as follows:

¹ Recherches sur l'influence de l'organisme sur les toxines. *Annales de l'Institut Pasteur*, 1898, vol. xii, p. 81.

² *Loc. cit.*, p. 263.

³ Weyl's *Handbuch der Hygiene*, 1897, 32 Lieferung.

The wonderful results obtained with the blood of immunized animals in the treatment of infectious and toxic diseases awakened the hope that immunity would receive a satisfactory explanation from the stand-point of humoral pathology. It was found, however, that those properties of the body fluids which were regarded as playing a prominent part in immunity are observed but very rarely in natural immunity, and occur almost exclusively in acquired, especially artificial, immunity. It was acknowledged that there is a wide difference between natural and acquired immunity. In natural immunity cellular peculiarities, such as the insensibility of the cells to poisonous and other microbial products, were looked upon as the important phenomena, while in acquired immunity humoral activities were placed in the foreground. These views naturally led to placing immunity upon a cellulo-pathological basis, because the primary rôle of certain cell elements could not be disregarded. Thus, Buchner replaced his early humoral theory of immunity with a new one, according to which the entrance of microbes into the organism arouses cellular activity, the leucocytes passing to the place of danger, and then and there excreting their microbe-killing products. Pfeiffer has also changed his purely humoral views, especially as regards acquired immunity, inasmuch as he ascribes an important part to living cells which are assumed to change the inactive antibodies into acting. When the living elements for any reason fail to perform their function, immunity is not established, even in the presence of large quantities of inactive antibodies. In natural and acquired insusceptibility to poisons a "histogenic immunity" must be assumed to exist, while the humoral theory is applicable only to the so-called passive, or "haematogenous" immunity, though even in this regard views diverge.

Taking a broad view of immunity, the sensibility of living protoplasm is found to be a factor noticeable everywhere, in natural as well as in artificial immunity, against poisons as well as against microbes, and in the simplest unicellular and multicellular organisms as well as in the higher animals, including man. The same forces which enable a bacterium or a yeast to adapt itself to the presence of originally harmful substances, or which permit a plasmodium to wander into salt or sugar solutions that it previously avoided, are also at work in the higher organisms when they accommodate themselves to the pathogenic products of bacteria. An inherited insusceptibility to toxins, as well as an inherited diminution of susceptibility, must be regarded as a well-proved fact. The faculty of adaptation is probably common for all cells of lower as well as higher animals. This becomes evident in the highest psychical functions of the human soul and in the simplest manifestations of life in the lowest beings. In immunity to poisons different elements are at work which, at the present time, cannot all be definitely characterized. In

immunity to living bacteria, the essentially active cells are to be regarded as phagocytes which incorporate living and virulent microbes, prevent their pathogenic action, or destroy them completely so that they are rendered definitively harmless. It is also probable that phagocytes are not entirely indifferent in respect to toxins, but this rôle cannot as yet be definitely outlined. It is self-evident that in their "struggle" against causes of disease, the phagocytes are aided by a number of secondary influences that are injurious to bacteria. Such accessory factors, oftenest observed in artificial immunity, must not, however, be looked upon as absolutely unavoidable or essential conditions.

The manifestations of sensibility are the controlling elements in the functions brought to light in immunity. Living cells, guided by their sensibility, approach or flee from pathogenic microbes, take up the microbes or not, and to this are added intracellular processes, in part of purely chemical nature, such as digestion, incrustation, etc. The complicated interplay of biological and chemical functions of living cells results in the evident manifestations of immunity. This doctrine of immunity as now formulated is, of course, far from exhausting the problem.

From the foregoing review of the pathology of the infections, it is apparent that a number of recent observations have been made which support Metschnikoff's views that cells, especially leucocytes, render harmless toxins as well as microbes. As every bacterium contains some toxin, a cell taking up this bacterium must have some means of altering the toxin as well as of destroying the bacterium (Metschnikoff). The directly destructive and other actions of toxins upon cells, elsewhere discussed, also show the close relation that may exist between toxin and cells. It is further quite evident that destruction of bacteria, as well as neutralization of toxins, may take place outside of the cells, and how far Metschnikoff and his followers are entitled to insist that this is a logical enlargement of the phagocytic theory (intracellular action), even though the active substances are cellular derivatives, may be questioned. It would seem that in this attempt to widen the phagocytic conception is to be seen a distinct compromise between the phagocytic theory and the cellulo-humoral theory of immunity, and that the latter phrase better expresses the present knowledge of this subject and gives, at the same time, due prominence to the essential rôle of the cells. This theory is broad enough to include the chemical explanations advanced by Ehrlich of the mode of action of antitoxins in healing and in passive immunity. In discussing the phenomena of healing and immunity, terms are frequently used that might be construed as expressing the notion that some processes are teleological and have a distinct purpose, but such is not the case. The processes referred to, as, for instance, certain cellular activities, are the result

of interactions and correlations of cells under various conditions, and take place whether the results are salutary to the organism or not. Bordet has shown that the blood serum of an animal injected with the serum of a second animal, of another species, contains substances of which one set agglutinates the red corpuscles of the second animal, and another set causes their disintegration, and are globulicidal; the serum of the first animal acts on the blood disks of the second in precisely the same manner as the serum of an animal vaccinated against cholera acts on the cholera vibrios (Pfeiffer's phenomenon). It is, indeed, fortunate that the cellular and other reactions in the infections are found to be so generally of such benefit to the organism.

In immunity there are also many, as yet obscure, features, some of which receive a measure of explanation on the score of "inheritance of acquired characteristics," as emphasized by Barlow.

PATHOGENIC MICRO-ORGANISMS.

The Bacillus of Tuberculosis—Botanical Position, Anomalous and Branching Forms, Variations in Virulence, Varieties, Pseudo-tuberculosis. From his study of the structure and development of the colonies of the bacillus of tuberculosis, Ledoux-Lebard¹ concludes that there are more grounds for placing this bacillus in the genus *cladotrix* than in the genus *streptothrix* (oöspora of the French). The typical *cladotrix* is a sheathed filamentous organism with false ramification, and each ramified *cladotrix* is a colony like any zoöglon, whereas a *streptothrix*, with its true branchings, is one and the same individual. In their growth Koch's bacilli, as well as the avian, group themselves after the type of the *cladotrix*—*i. e.*, as ramifying, segmented filaments. The *cladotrix* differs in the mobility of its isolated segments. Ledoux-Lebard proposes to keep Metschnikoff's new name for the tubercle bacillus, namely, *sclerotrix* Kochii, but to transfer the bacillus to the genus *cladotrix*.

Anomalous branching and club-shaped forms of the tubercle bacillus, in cultures, in the sputum,² and in the tissues, have been described, and on this account the view has been advanced by some that the tubercle bacillus, and for similar reasons the bacillus of diphtheria also, may in reality belong to, or at least be regarded as closely related to, the strepto-

¹ *Manual of General Pathology*, 1898, p. 411.

² *Arch. de Méd. Expériment. et d'Anat. Path.*, 1898, vol. x, p. 337.

³ C. F. Craig, *Journal of Experimental Medicine*, 1898, vol. iii., found true branching and intermediate stages in almost every preparation of the sputum of a tuberculous patient; the article contains a good résumé of the literature.

thrux group of micro-organisms. (Plate I.) Babes and Levaditi describe an "actinomycotie" form of the tubercle bacillus, the development of which they traced after injecting pure cultures, of slight virulence, into the meninges of rabbits. In two or three days undulating filaments formed, often in masses, which in eight or ten days presented radiating peripheral ends, and later acquired nodular thickenings and even distinct clubs. The masses, whose diameters were from 40 to 80 μ , much resembled the characteristic bodies of actinomycosis. Ehrlich's stain showed a central mycelial network, while anilin-safranin, followed by Lugol's solution, stained the club-shaped bodies red, and Gram's method gave an isolated stain of the mycelium. Babes and Levaditi believe it is not unlikely that sooner or later lesions at first regarded as actinomycotie will be found to be tuberculous, due to an actinomycelial form of the tubercle bacillus. When it is remembered that the histological pictures of actinomycosis and tuberculosis may be in some respects identical, it is easy to understand that this confusion may readily arise, if the above observations are confirmed.

Lubarsch¹ also obtained actinomyces-like growth of tubercle bacilli by placing a loopful of bacilli in small wounds in the liver, kidney, or mammary gland; the bacilli assumed a radiating arrangement with club-shaped thickenings of the free ends. He assumes that this peculiar form of growth results when many bacilli become crowded into a small space so that further growth is hindered; the clubbed formations are probably the result of degenerative changes.

Vagedes² shows by suitable experiments that human tubercle bacilli from different sources have varying degrees of virulence.

From thorough comparative studies of bacilli of mammalian tuberculosis, Theobald Smith³ reaches the following conclusions: Bovine and other animal bacilli grow less vigorously for a number of generations than the sputum bacilli; they are less influenced by modifications in the culture media, and they tend to remain short. Cattle inoculated with bovine bacilli generally lose weight and develop a more or less extensive tuberculosis, while cattle inoculated with sputum bacilli gain some in weight and there develops only a purely local, non-progressive, atypical tuberculosis around the seat of puncture into the lung; occasionally the sputum cases fail to develop any disease. This establishes a distinctively human and bovine variety of tubercle bacilli, the human having but

¹ *Centralbl. f. allg. Path. u. path. Anat.*, 1898, vol. ix. p. 857.

² *Experimentelle Prüfung der Virulenz von Tuberkelbacillen. Zeitschr. f. Hygiene u. Infektionskrankheiten*, 1898, vol. xxviii. p. 276.

³ *A Comparative Study of Bovine Tubercle Bacilli and of Human Bacilli from Sputum. Journal of Experimental Medicine*, 1898, vol. iii., and *Trans. Assoc. of American Physicians*, 1898, vol. xiii. p. 417.

PLATE I



Anomalous and Branching Tubercle Bacilli from Sputum (CRAIG)

slight virulence for cattle. Askanazy¹ describes two cases of tuberculosis in man which assumed the neoplastic form of pearly disease in cattle. The true interpretation of such cases will remain obscure until the etiological agent is studied; the variable character of tissue reaction to tubercle bacilli, according to species, deprives pathological study, taken alone, of any decisive value in view of the probable existence of distinct bacillary varieties.

The question raised by Smith, of the transformation of one variety of tubercle bacillus so as to correspond with the cultural and pathogenic peculiarities of another, is one of great practical importance in relation to the source of infection, and it has received an important contribution in Nocard's² valuable study of the bacilli of mammalian and avian tuberculosis. These microbes are generally regarded as distinct, because of well-defined cultural and pathogenic differences. Nocard took advantage of the peculiar conditions offered by cultivating the bacilli in small collodion sacs in the bodies of animals. These sacs permit of a ready change in the composition of the fluid they contain, thus preventing auto-intoxication of the bacteria while the fluids of the animal incubator enter the sac gradually. Sacs containing bacilli of human tuberculosis were inserted into the abdomen of chickens, and, after four months, cultures of the now thick fluid in the sac presented colonies which resembled greatly those of the avian type of bacilli, being soft and unctuous; after six to eight months the bacilli had become pathogenic for chickens, the lesions produced being identical with those of natural avian tuberculosis.

It appears that by this method it is possible to change the bacillus of mammalian tuberculosis so as to make it very similar to, if not identical with, the avian. It will be recalled that Koch's bacillus is not, originally, pathogenic for fowls. Nocard concludes that these two bacilli, apparently so different, are but varieties of the same species.

Spontaneous and experimental pseudo-tuberculosis—*i. e.*, a disease characterized by nodules in which the causal agent is not the bacillus of tuberculosis, has been described in guinea-pigs, rabbits, and other animals by Malassez and Vignal, Nocard, Pfeiffer, Kutscher, and others, as due to a non-liquefying bacillus occurring in zoöglon masses or discretely. Robert Muir³ describes an identical or closely related disease in singing birds, characterized by the appearance in the spleen and liver of small yellow nodules composed chiefly of masses of bacilli, whose growth starts from the capillaries and results in but slight reactive changes. The bacillus is readily cultivated; on gelatin it resembles the bacillus of

¹ Zeitschrift f. klin. Med., 1897, vol. xxxii. p. 360.

² Annales de l'Institut Pasteur, 1898, vol. xii. p. 561.

³ On Pseudo-tuberculosis, with Especial Reference to Pseudo-tuberculosis in Birds. Journal of Pathology and Bacteriology, 1898, vol. v. p. 160.

typhoid; it does not stain by Gram's method, and is not sporogenic; in tissues it is best stained by carbolfuchsin. Experimental inoculations were successful in birds as well as in rodents, the lesions in the latter being more cellular, but in both the spleen and liver were most affected.

Paul Courmont¹ would apply the term tuberculosis to all diseases characterized by nodules, and would reserve pseudo-tuberculosis for the proliferations which occur around inert foreign bodies. Whether this is more logical than to limit tuberculosis as at present, and to designate other tubercular diseases as pseudo-tuberculosis, may well be questioned. In one case stress is laid more on the character of the lesion, in the other, on the causal agent; in neither is the nomenclature, although convenient, a very desirable one.

Courmont studied a fibrino-hemorrhagic and productive synovitis with typical caseous tubercles without the presence of the tubercle bacillus. From the nodular lesions that developed in guinea-pigs after subcutaneous injection of fluid from the joint, he isolated and cultivated an immobile bacillus which forms chains and produces in animals nodular, exudative, and quite often hemorrhagic lesions, which, in the nodular form, present a striking histological similarity to experimental miliary tuberculosis.

Alfred Moeller² isolated from timothy hay, vegetables, and feces of cows, horses, goats, hogs, and mules a bacillus which resembles very much the tubercle bacillus in cultural properties. Inoculated into rabbits and guinea-pigs, a picture resembling miliary tuberculosis often developed, and in some cases pulmonary lesions with cavities resulted. Microscopically such lesions resembled very closely tubercles; they contained giant cells and bacilli which stained like tubercle bacilli. Cultures from the lesions in the animals did not grow readily for a time, again resembling tubercle bacilli. Cases where the lesions closely resembled tuberculosis were, however, exceptional. In most cases one accustomed to tuberculosis in these animals would not recognize it as tuberculosis, but in many cases the resemblance was bewildering. Moeller thinks that this is a new, not previously described, bacillus. It is different from those described in butter. It belongs to the same class as does the tubercle bacillus of mammals and birds.

Pseudo-diphtheria Bacillus. Noma Caused by the Bacillus of Diphtheria. C. Fränkel³ concludes that in general the diphtheria bacilli possess a marked virulence and when injected subcutaneously kill guinea-

¹ Sur une forme nouvelle de tuberculose strepto-bacillaire d'origine humaine. Arch. de Méd. Expériment., 1898, vol. x, p. 42.

² Mikro-organismen, die den Tuberkelbacillen verwandt sind und bei Thieren eine miliäre Tuberkelkrankheit verursachen. Deutsche med. Woch., 1898, p. 376.

³ Die Unterscheidung der echten und der falschen Diphtheria-bacillen. Berl. klin. Woch., 1897, No. 50, p. 1087.

pigs in forty-eight to seventy-two hours, while the pseudo-diphtheria bacilli do not. This is not always so; sometimes a very large quantity of diphtheria bacilli is required and takes longer to produce the results. On the other hand, the pseudo-bacillus is not always so harmless as at first supposed, for not infrequently local results are produced, and occasionally a general poisoning of the animal. Escherich, Roux, and Yersin have noticed marked emaciation. Fränkel has had more than two hundred guinea-pigs die with marked loss of weight from five to six weeks after injection with from 10 to 20 c.c. of bouillon culture of the pseudo-bacillus. At autopsy no characteristic changes were found, except at times a hemorrhagic peritonitis.

Roux and Yersin, by injecting simultaneously a culture of virulent streptococci, changed pseudo-diphtheria bacilli (non-virulent bacilli) into virulent bacilli, and Trumpf recovered virulent diphtheria bacilli after injecting a culture of pseudo-diphtheria together with diphtheria toxins. Other observers properly hold the dualistic stand-point.

Fränkel believes that a questionable organism, which fails to take Neisser's¹ stain, is not the true diphtheria bacillus. In his hands this stain failed only in a culture grown outside the body for years, which showed only a few bacilli with granules. The opposite is not so true. Out of fifty-four cultures of pseudo-diphtheria bacilli obtained from the normal conjunctiva, one showed the granular staining. These granules could not be recognized as different from those in diphtheria bacilli.

A. de Simoni² studied, from ozena secretion, a typical non-pathogenic pseudo-diphtheria bacillus which possessed the remarkable property of producing spores when inoculated on milk and potato, but not on other media. The relation of this spore-forming bacillus to Neisser's stain was not determined.

The writer has recently had occasion to study a typical pseudo-diphtheria bacillus which occurred in huge numbers as a mixed infection in a blastomycetic dermatitis of the back of the hand (Dr. Bevan's patient). The bacillus is negative to Neisser's stain, but is pathogenic after subcu-

¹ Neisser's (*Zeitschr. f. Hyg. u. Inf.*, vol. xxiv, p. 443) differential staining for the granules in diphtheria bacilli is as follows:

1. 1 gramme of methylene-blue is dissolved in 20 c.c. of 96 per cent. alcohol; to this are added 950 c.c. of distilled water and 50 c.c. of glacial acetic acid.
2. 2 grammes of vesuvium dissolved in 1 litre of boiling water (filtered).

Smears are stained for 1-3 seconds in solution 1, washed in water, then in solution 2 for 3-5 seconds, and then washed. Cultures on Loëdler's medium must be used; they should be grown for at least nine and not more than twenty to twenty-four hours at 34° to 35° C.

Neisser found that, with few exceptions, pseudo-diphtheria bacilli do not take this double stain.

² Ueber einen sporogenen Pseudo-Diphtheria bacillus. *Centralbl. f. Bakt., etc.*, Abth. 1, 1898, vol. xxiv, p. 294.

taneous inoculation to guinea-pigs, sometimes with, sometimes without, local lesions, the animals dying greatly emaciated in about from three to four weeks. Diphtheria antitoxin has no protective action.

Freyrnuth and Petruschky¹ describe a case of gangrenous vulvitis (noma genitalium) and one of noma of the cheek, the first occurring in measles, the second in typhoid fever, in both of which virulent diphtheria bacilli were isolated from the gangrenous tissue, and in both of which healing succeeded the use of antitoxic serum. They also mention finding diphtheria bacilli in a case of gangrene of the foot in a middle-aged man.

Bacillus Hydrophilus Fuscus. Russell² describes a devastating epidemic among frogs, caused by the bacillus hydrophilus fuscus, which was first isolated by Sanarelli in 1891. It concerns a water organism, a short, thick bacillus with rounded ends, which possesses active motility, has but one flagellum, is chromogenic, gas-producing, and aerobic, but grows also to some degree without oxygen. Gelatin is liquefied, bouillon diffusely clouded; upon agar-agar there is produced in a few days an amber color, and it also colors the media; potato produces chocolate-colored growth; litmus is made acid; glycerin agar produces ash-white growth but does not change in color, and glucose-agar shows gas-formation. It grows best at body temperature, and does not stain by Gram's method. The cold-blooded animals for which it is pathogenic are frogs, toads, salamanders, lizards, sunfish, and fresh-water eels. The warm-blooded animals which succumb to infection are guinea-pigs, rabbits, new-born dogs, new-born cats, common mice, field mice, bats, chickens, and pigeons (Sanarelli).

The virulence of the organism varies greatly. Cultures gradually lose their virulence with age, but blood taken from the animal and sealed in tubes will retain it for months. Infection produces a septicæmia. Warm-blooded animals are seized with shivering and restlessness, followed by prostration and death. Cultures can be obtained from the blood and from all the fluids and organs of the body. Exudation of blood-stained fluid occurs in all the serous cavities, being especially marked in the peritoneum.

Histologic examinations reveal focal necroses in the spleen, liver, brain, and spinal cord, with congestion in other organs. In the frog intermuscular hemorrhages occur, with destruction of the muscular fibres. The organism produces two distinct and powerful toxins, one resembling in its action digitalis, and the other resembling veratrine.

Streptothrix, Actinomyces, etc. It appears that the genus streptothrix occurs freely in the external world, its spores often being present

¹ Deutsche med. Wochenschrift, 1898, No. 15, p. 232, and No. 38, p. 600.

² Journal of the American Medical Association, June 18, 1898.

on grass and grain particularly. Berestneff¹ readily succeeded in isolating several varieties from grass and straw by planting moist pieces either on the usual media or in moist sand. The cases of bovine and human actinomycosis in which portions of plants, most frequently barley, have been found in the lesions, are now so numerous that their rôle as a common vehicle seems quite probable. Behla² attempted to identify the streptothrix of typical actinomycosis on the basis of the clubbed masses which, contrary to the general view, he regards as conidia, with fungi in nature. With this end in view he studied the parasites of barley, and in the course of many experiments secured vegetations of actinomyces upon bits of barley stubble, which, covered with a widely distributed plant-mould known as *cladosporium herbarum*, had been inserted in the oral mucous membrane of small pigs. While Behla could not definitely identify streptothrix with any of the common plant-moulds, he suggests that it, as well as many bacteria, may in their parasitic form represent developmental stages in higher fungi.

Francis Harbitz's³ experiments with the organism of human actinomycosis are thorough and interesting. From five typical cases numerous, in some instances repeated, inoculations were made upon various media, which were kept partly under aerobic, partly under anaërobic, conditions; of sixty-four primary cultures, growth of streptothrix actinomyces took place in only twenty. The growth was slow and gradual; on the second to the fourth day there would appear small, white, adherent and compact masses, which always remained isolated; most of the colonies reached the size of a pin's head, were evenly round, white or yellowish-white; the colonies, always dense, grew down into the solid media; occasionally there would form a continuous film on bouillon, in which the growth generally took place in the shape of separate masses. A few colonies on agar and serum presented peculiar star-forms with numerous radiations, or looked like pyramids cut across; these colonies were white with a yellowish-brown tinge, rather soft, of rapid growth, and extended deeply into the medium; they appeared oftener in aerobic cultures. After the first generation the organisms seemed to do better when grown without oxygen; the actinomyces grew well when inoculated in eggs in the usual manner, taking the form of numerous, semitransparent, grayish-yellow grains, of irregular size and form, scattered throughout the yolk regularly or irregularly, and also in the inner layers of the white. Rosettes or clubs were not seen in the cultures; occasionally calcification would occur in the centre of older colonies. The reaction of the agar used did not seem to

¹ Zeitschrift f. Hygiene u. Infektionskr., 1898, vol. xxix, p. 94.

² Ueber die systematische Stellung des Erregers der Aktinomykose. Centralbl. f. Bakteriologie, etc., Abth. 1, 1898, vol. xxiii.

³ Norsk Magazin for Lægevidenskaben, 1898, vol. lix, p. 1.

be of any import, growth taking place as well on acid as on alkaline agar. Milk would occasionally give rise to growths, but there was no coagulation. The colonies consisted of longer and shorter threads which stained by Gram's method, and always presented true branching, although Harbitz states that sometimes the branches were hard to find; in the older cultures the threads were granular and fragmented, forming structures like bacilli and cocci; usually the threads were of the same thickness, though occasionally one end presented some enlargement. Harbitz's cultures were rather short-lived; in one case he succeeded in keeping the growths alive through eleven generations during seven months; in two cases through four generations in three and a half months, but in five cases death occurred after the first generation; at each transplantation he took the precaution to inoculate from ten to fifteen new tubes.

Harbitz made a large number of inoculation experiments (subcutaneous, intraperitoneal, intrapleural, intravenous) on rabbits, guinea-pigs, and mice. He failed to produce a fatal actinomycosis, and yet many features recalled the pictures of the disease. When large agar-clumps with numerous grains were inserted they were found weeks and months afterward encapsulated in fibrous adhesions which contained mycelial grains surrounded by a reddish halo, but there were no yellow rosettes and no clubs; the microscope showed longer and shorter threads in a cellular tissue with epithelioid cells and giant cells enclosing clumps of agar. There was no dissemination; the process was one of absorption and mild inflammatory reaction. The fungus may, of course, have developed as in any other incubator—that is to say, the clumps increased in size, the colonies in the agar increased in number after the inoculation, and calcification also occurred. In one intrapleural experiment yellow masses were found in adhesions in the anterior mediastinum; in another a sore formed in the inguinal region, in which were found rods, but no rosettes, and Harbitz thinks this may have resulted from an infected lymph-gland after abdominal implantation; the most convincing experiment (intraperitoneal inoculation of a rabbit) showed, after three months, typical rosettes, but these were enclosed in a dry fibrous capsule.

Observations like those of Harbitz indicate plainly that the organism isolated by Max Wolf and James Israel from two cases (human), presenting the ordinary features of actinomycosis and successfully reinoculated into animals, is not the sole and constant cause of actinomycotic processes, as quite generally believed. In the first place, the microbe of Israel and Wolf differs from the streptothrix commonly obtained from human, as well as bovine, actinomycoses, in its cultural peculiarities; thus, it grows better without than with oxygen; it forms branches only in egg cultures, while on all other media it presents itself as cocci or short, plump, often curved rods. In the second place, the case with

which Wolf and Israel produced experimental infections also distinguishes it from the streptothrix of actinomycosis.

There seems to be good reason to believe that actinomycosis, as currently understood, may be caused by different varieties or modified forms of streptothrix. The pathogenic powers of the streptothrix group are becoming more and more apparent in the increasing number of streptothrix infections described, which differ more or less in clinical, anatomical, and bacteriological aspects from the typical actinomycosis.

Berestneff¹ proposes to unite all streptothrix infections under one name—actinomycosis—and all the various organisms concerned in one group—the actinomyces group. Typical actinomycosis is the familiar disease in which occur the characteristic mycelial masses with club-shaped radiations. Atypical actinomycosis includes such diseases as Nocard's farcin de bœuf, and cases like those of Eppinger, Sabrazes and Riviere, and others, infections which clinically and anatomically resemble actinomycosis, and are caused by branching mycelial organisms which correspond quite closely to the cultural peculiarities of the streptothrix actinomyces, but fail to form the characteristic grains in the tissues and pus.

In the interest of simplicity of nomenclature and in the presence of an already formidable list of synonyms (actinomyces, cladothrix, streptothrix, oöspora, nocardia), mycelial organisms with true branchings should certainly receive a uniform designation. In Flügge's work Krause finds that in the present uncertainty as to the true botanical position of this group the term streptothrix is perhaps the most applicable. There being no essential principle at stake, it would certainly be well in a question like this to follow the lead of a standard text-book rather than arbitrarily to enlarge the significance of the word actinomyces as recommended by Berestneff.

Under pseudo-actinomycosis Berestneff would include the rare instances of diseases which resemble actinomycosis clinically and anatomically, and in the lesions of which there occur actinomycelial-like bodies, but which, in reality, are caused by organisms that on account of their cultural and other characteristics belong to the bacteria. Some of these bacteria do not stain by Gram's method, as, for instance, the anaërobic bacilli described in such cases by Sawtschenko and by Berestneff. In the larger number of cases of pseudo-actinomycosis the organisms stain by Gram's method; among these may be mentioned Poncet's case, in which he isolated the bacillus pseudo-actinomycoticus Dori, and Berestneff's cases due to the cocco-bacillus pseudo-actinomycoticus pleomorphus. The organism of Wolf and Israel, above referred to, belongs here also. In all these cases

¹ Actinomycosis and its Causes, Moscow, 1897 (Russian), and Ueber Pseudo-actinomycose, Zeitschr. f. Hyg. u. Infektionskr., 1898, vol. xxix, p. 91.

the clinical and histological features recalled those of actinomycosis proper. The bacteria concerned resemble greatly, in the tissues, the so-called actinomycotic form of the tubercle bacillus (Babes and Levaditi), and in some instances they stain with Ziehl's method; like the atypical tubercle bacillus, some of these bacilli also form short branching threads and radiations with club-shaped ends.

While the number of diseases caused by branching and other organisms more or less similar to the tubercle bacillus, and marked by inflammatory new-formations, continues to increase, it will be noticed that the difficulties of classification and the complications of nomenclature also multiply. As in the case of pseudo-tuberculosis, which includes various infrequent diseases, and among them cases such as Flexner's, which Berestneff would class as atypical actinomycosis, so pseudo-actinomycosis cannot be said to be a logical or scientific term, but, rather, one of temporary, practical convenience only.

Flexner¹ describes as occurring in a man seventy years old a streptothrix infection, which clinically appeared as a pulmonary tuberculosis, anatomically as a caseous pneumonia, with but few epithelioid and giant cells. (Plate II.) Smears and section showed a mycelial organism with true branching, most numerous in the areas of disintegration. There was also an anatomical tuberculous peritonitis, and anatomical tubercles were found in the spleen, liver, and mesenteric glands; in the omental nodules, which greatly resembled true tubercles, the organism appeared as a curved or angular rod, staining in beaded form, and exceeding the tubercle bacillus in length and breadth.

For staining the organism Flexner found that hæmatoxylin followed by carbol-fuchsin and aniline oil gave best results. Tubercle bacilli could not be demonstrated by ordinary methods, and culture as well as inoculation experiments gave negative results.

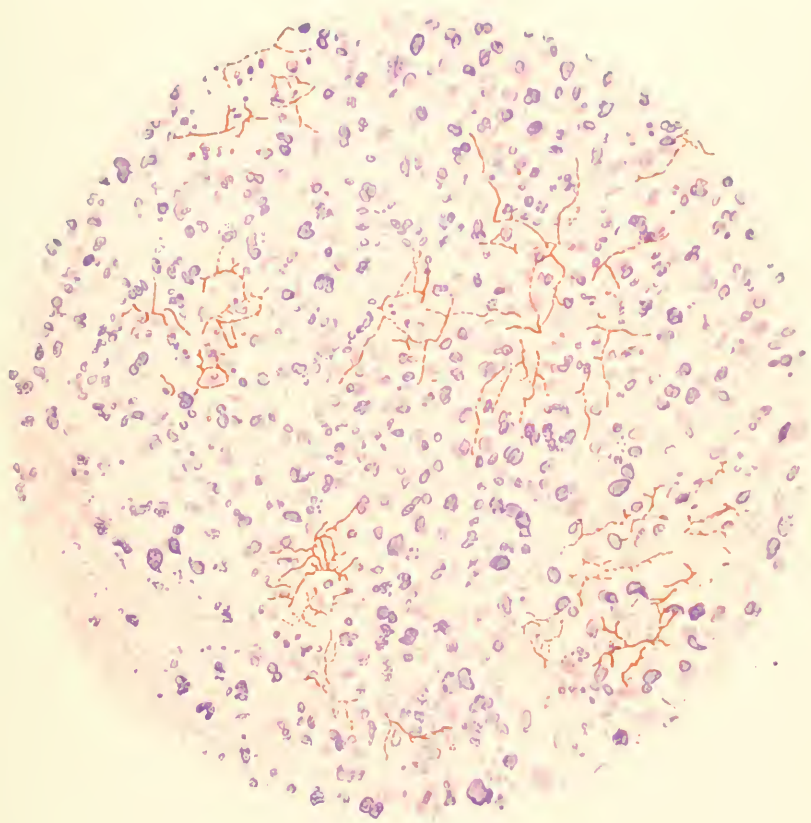
Interesting in many respects, this observation emphasizes also the ease with which mistakes in the anatomical diagnosis of tuberculosis may be made.

II. Buchholtz's² case of streptothrix of the lung presented the anatomical picture of tuberculosis, with involvement, however, of the lower lobes only. There were no tubercle bacilli present. Histologically the lesions resembled those of fibrinous pneumonia; in the infiltrated and necrotic tissue Gram's stain showed a thick network of long, branching threads; there were no short rods or coccus-like bodies; the streptothrix occupied the alveoli, while streptococci were present in the

¹ Pseudo-tuberculosis hominis streptotricha. *Journal of Experimental Medicine*, 1898, vol. iii. p. 435, and *Trans. of Association of American Physicians*, 1898, vol. xiii.

² Ueber menschenpathogene Streptothrix. *Zeitschr. f. Hygiene u. Infektionskrankheiten*, 1897, vol. xxiv. p. 470.

PLATE II



Section of the Lung in Streptothrix Infection. (FLENNER)
Hæmatoxylin and Carbol-fuchsin.

bronchi and the lymph vessels. The streptothrix could not be cultivated. The following stain is recommended for demonstrating the mycelial network: stain for twenty to thirty minutes in a saturated solution of crystal violet in alcohol, with 20 per cent. of aniline and 20 per cent. of phenol, and decolorize with aniline oil only.

Petrusky¹ obtained cultures of a streptothrix from the sputum of a child suspected to have phthisis. This streptothrix produces abscesses in rabbits.

Rullmann² isolated a streptothrix from small, yellowish-green nodules in the sputum of a woman who had some obscure lung affection. The organism has true branching, stains by Gram's method, and grows readily on artificial media, on some of which it forms rods with nodular thickenings much resembling the diphtheria bacillus; the odor of the culture is mouldy or earthy, characteristic of streptothrix in general; it is pathogenic for mice, guinea-pigs, and rabbits.

Moulds — Aspergillosis, Melanoid Form of Mycetoma. The pathogenic action of the hyphomycetes *aspergillus fumigatus* is studied by Obici.³ At the present time the "gaveurs des pigeons" of Paris, each of whom may feed as many as 2000 pigeons daily with grain, which the birds pick from his lips, furnish not a few examples of pulmonary aspergillosis, which commonly runs the clinical course of a slow tuberculosis. Spontaneous general infections, in which there are wide-spread hemorrhages, occur in the cow and the horse, the blood and the organs containing spores in large numbers.

The intravenous injection of spores into laboratory animals is fatal in from four to six days; there develop numerous nodules composed of leucocytes, an occasional giant cell of the tuberculous type, and spores as well as sterile threads. Sporangia do not develop in the tissues except in the lungs and the bronchi, where the parasite comes in contact with the air. The present writer observed sporangia develop in the anterior chamber of the rabbit's eye. The injection of large quantities of spores may result in death before nodules have time to form. In guinea-pigs and rabbits the nodules are especially numerous in the kidneys, while in the pigeon they are most numerous in the liver; the brain is apparently rather immune. The disease can also be produced by feeding the spores, by intraperitoneal injection, and, in the case of pigeons, by inhalation; injection into the cornea causes first an aspergillous keratitis as observed in man, followed by extension and general infection. Death occurs more slowly after these modes of infection than after injection into the blood.

¹ Verh. des XVI. Congr. f. innere Medicin. Wiesbaden, 1898.

² Ueber eine aus Sputum isolirte pathogene Streptothrix. Münch. med. Wochenschrift, July 19, 1898, No. 29, p. 919.

³ Ziegler's Beiträge, 1898, vol. xxiii, p. 197.

The injection of filtered cultures causes a slight rise of temperature, and when repeated a certain degree of immunity is produced.

In the hands of the present writer filtered bouillon cultures of *aspergillus fumigatus*, isolated from a spontaneously infected rabbit and reinoculated with the development of typical lesions, caused death in rabbits in twenty-four to thirty-six hours, and the only lesions found were marked congestion of the lungs and the thymus, and cloudy swelling and typical focal necroses in the liver and the spleen, which were more numerous in the first. It was also noticed that in the lungs the threads sometimes assume a nodular and radiating form, resembling somewhat the mycelial masses of actinomycosis. The original cultures soon lost their virulence.

James H. Wright¹ describes the fourth American case of mycetoma, his case being the first of the "melanoid" or black variety, all the previous cases (those of Adami and Kirkpatrick, Hyde, Senn and Bishop,

FIG. 4.



Mycetoma. Black granule with mycelial growth proceeding from it (WRIGHT).
From a bouillon culture.

and Pope and Lamb) being of the "oehroid" or pale variety, and all very suggestive of actinomycosis, whereas Wright's case was due to a hyphomycetes. The disease involved the left foot of a twenty-six-year-old Italian woman, who had lived in America for years. In the discharge from the sinuses were numerous black grains like gunpowder. (Figs. 4 and 5.) Under the influence of sodic hypochlorite the granules softened and were found to consist of separate branching hyphæ, without

¹ A Case of Mycetoma (Madura Foot). *Journal of Experimental Medicine*, 1898, vol. iii. p. 422, and *Trans. of Assoc. of American Physicians*, 1898, vol. xiii.

distinct spore-bearing organs. The sowing of such bodies in sixty-five liquid culture tubes was followed by the growth, in twenty-five, of puff-ball-like masses composed of long hyphae, 3 to 8 mikrons in diameter, with true ramifications and septa in the younger cultures, and without sporangia. The organism grows readily on all media, and in the midst of the mycelium of the old cultures appear the black grains described, which Prof. Farlow regards as *sclerotia*; it is not pathogenic to animals.

FIG. 5.



Mycetoma. Potato culture of the organism. The black globules are composed of a dark-brown fluid (WRIGHT).

Histologically the lesions showed leucocytes, epithelioid, lymphoid, and plasma cells, as well as multinucleated plasmodial masses, foci of supuration, and, in other places, connective-tissue growth.

Blastomycetes. Gilchrist and Stokes¹ describe an additional example of blastomycetie dermatitis which presented, clinically, some of the features of lupus vulgaris. Histologically the epidermis showed marked hyperplasia with numerous miliary abscesses, inflammatory infiltration of the corium, and, occasionally, almost typical tubercles. In the miliary abscesses, as well as elsewhere, were spherical, unicellular bodies, from 10 to 20 μ in diameter, consisting of a doubly contoured membrane around a granular protoplasm; many budding forms appeared, but there were no mycelium or hyphae in the tissues. Pure cultures of the organism were obtained from pus squeezed out of the papillomatous form of the lesion; the organism grew on all media, but especially well

¹ Pseudo-lupus Vulgaris caused by a Blastomycetes. *Journal of Experimental Medicine*, 1898, vol. iii. p. 53.

on potato and beer-wort agar, and the cultures, when not too old, showed budding oval and doubly contoured forms, as well as a mycelium with sessile buds and conidia. Dogs, a horse, a sheep, and guinea-pigs were successfully inoculated, and tumor-like nodules of a chronic inflammatory character, containing numerous parasites, were found in the lungs. As this organism did not ferment sugar, and produced in cultures mycelium, it may belong to the blastomycetes or to the oidia, but, in accordance with prevailing nomenclature, Gilchrist and Stokes regard it as a blastomycetes, the *blastomycetes dermatitidis*.

An apparently identical case, as far as the histological changes and the appearance of the organism in the tissues are concerned, is described by H. G. Wells.¹ Attempts to cultivate the organism failed.

Robert Hessler² makes a preliminary report of a case in which a small hard nodule developed in a small wound. In about three months the nodule began to grow, and soon "came to a head." In the contents were budding organisms which grew on agar in the form of small, bright colonies of budding cells with a clear outer envelope and granular contents. When grown on solid media for a longer time "fungous threads" appeared. After the incision of the abscess a disproportionately large scar formed, and new papules developed in its vicinity. The final report has not yet appeared.

The writer is engaged in the study of a case, as yet unpublished, of blastomycosis of the whole dorsum of the hand, which is under the care of Dr. A. D. Bevan. Clinically and histologically this case resembles minutely that of Wells. A peculiar, pathogenic budding organism has been isolated. An interesting feature in this case is a mixed infection with a pathogenic bacillus which morphologically corresponds to the pseudo-diphtheria bacillus. (Plate III., Fig. 1.)

The relation of blastomycetes to tumors is discussed elsewhere.

RETROGRESSIVE CHANGES.

Necrotic and Other Changes of Toxic Origin. From an exhaustive study of the pathology of toxalbumin intoxication by Simon Flexner,³ we cull the following concerning the pathogenesis and significance of the lesions due to intoxication: After having proved beyond any doubt that profound alterations in the nuclei and in the whole cell structure are caused by soluble toxic bodies, attention is called to the fact that the lymph-cells, on account of molecular or functional peculiarities, or both, suffer more than the epithelial cells; of the latter those of the liver are

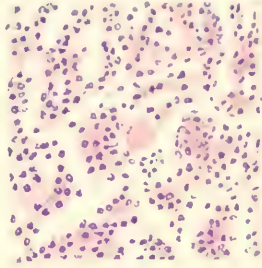
¹ New York Medical Journal, March 26, 1898.

² Indiana Medical Journal, 1898.

³ Johns Hopkins Hospital Reports, 1897, vol. vi.

PLATE III.

FIG. 3.

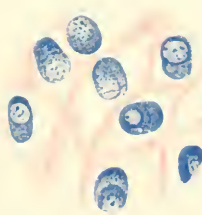


Blastomycetic Dermatitis.

Contents of Miliary Abscess with a Blastomyces in the Centre. $\times 750$.

(See page 346.)

FIG. 4.



A Group of Plasma Cells from Actinomycotic Granulation Tissue.
Polychrome Methylene Blue and Orcein. $\times 750$.

(See page 348.)

most affected, those of the pancreas least. The degree of cell injury in any organ is more or less proportional to the activities exerted by it in dealing with the poison in question. This is seen well in the case of the liver. The intestines suffer very severely in ricin and abrin intoxication, because these poisons are eliminated by the gastro-intestinal tract. The intestinal lesions in diphtheria intoxication are produced in the same manner, and not, as Oertel supposed, by the transport of the poison by the diseased cells or by the swallowing of diphtheric material.

The "parenchymatous degenerations" of organs are diffuse changes due to the equal action of the soluble poisons upon the cells; the characteristic focal changes, on the other hand, are referred to irregularities in the capillary circulation resulting in injury to the capillary walls, which then become abnormally permeable, allowing the poison to pass out and to act with greater intensity upon adjacent cell groups, which then undergo necrotic changes. The frequent existence of intracapillary thrombi about foci of necrosis has been regarded by some (Klebs, Barker, and Schmorl) as the precursor, and even as the cause, of cell-death, on account of the resulting anaemia. Thrombi are not constant about the foci of necrosis, however, and Flexner argues that the thrombosis is to be regarded rather as incidental. In the focal necrosis described by Le Count in certain forms of general tuberculosis, there were no evidences histologically of capillary thrombosis, the cell-death in this instance being traced to the action of the tubercle bacillus, whose presence he could demonstrate in the necrotic area.

The types of cell-death described most often belong to the coagulation form of necrosis. The prevalence of karyolysis is regarded as being due to chemical agents which cause a rapid transformation of the nuclear material. Karyorrhexis is also a common occurrence in the necrosis of intoxication. Phagocytosis of the detritus is a common phenomenon.

Focal necrosis due to toxalbumin intoxication occurs in a very characteristic manner in diphtheria, but I cannot regard the process, as does Oertel, as being specific, for it occurs in many mycotic and other affections and intoxications, experimental and otherwise.

The fate of the focal lesions, when early death does not take place, consists in the removal of the necrotic material by phagocytosis, followed in some cases by regeneration, but oftener by scar formation.

The evidence brought forward goes to show that profound and widespread lesions occur in the animal body from the action of soluble poisons; such lesions, though resembling those produced by some bacteria as such, may result independently of the presence of bacteria in the tissues involved, and even when the action of living organisms can be entirely excluded. The changes following burns may be brought forward as an illustration of the last condition.

Many hypotheses have been advanced to explain the general symptoms of extensive surface burns; of late the view that toxic substances are produced and enter the circulation has become rather prominent. Definite proof of the production of toxic substances was not at hand, however, until Bardeen¹ succeeded in showing that after burns the lesions in the internal organs very much resemble those of better-known toxæmias. This author systematically investigated the organs of five children who died from four to nine and a half hours after extensive cutaneous burns. There was found a wide-spread parenchymatous degeneration with numerous areas of cell-pigmentation in the lymphatic tissues, such as follow toxalbumin intoxications, indicating that strong poisons in the blood played a prominent part in the fatal result.

Mallory's study² of the histological lesions of typhoid fever also calls our attention to a variety of changes of toxic origin. The intestinal lesions depend primarily, he believes, on the proliferation of the endothelial cells of the lymphatic reticulum; the new cells are characterized by irregular curved nuclei, abundant protoplasm, and marked phagocytic powers, and they often contain from ten to twenty lymphoid cells, less often plasma cells, red blood-disks, and polymorphonuclear leucocytes. The incorporated cells are gradually digested. Similar changes may occur more or less diffusely in the lymphatic cells. Such cells also develop from the vascular endothelium. The degeneration of the phagocytic cells gives rise to an abundant precipitation of fibrin, and thus necrosis and secondary inflammatory changes ensue. Like changes occur in the mesenteric lymph nodes, the splenic follicles, and the bone marrow. The formation and degeneration of phagocytic cells from the vascular endothelium may give rise to fibrin and consecutive necrosis. The portal circulation becomes loaded with intestinal and splenic phagocytic cells which may occlude the intralobular capillaries and thus cause focal necrosis. Phagocytic cells also form in the periportal lymph spaces. Accumulations of phagocytic cells occur in various organs, and at times they appear to form *in loco*, as, for instance, in the heart-walls.

Mallory regards these interesting changes as due to the action of a mild toxin, partly absorbed by the intestine, partly produced afresh in some of the organs and in the blood. The changes are not characteristic of typhoid fever, except in location, degree, and sequence. Dr. Le Count has shown the writer similar changes in the capillaries of the liver from a chronic streptococæic endocarditis with general infection.

It is to be noted that the explanation by Mallory of the genesis of the

¹ Journal of Experimental Medicine, 1897, vol. ii.

² A Histological Study of Typhoid Fever. Journal of Experimental Medicine, 1898, vol. iii.

typhoid ulcer differs radically from the one usually given, and this is also the case as regards the focal necrosis seen in typhoid fever.

Foa¹ observed an extensive phagocytic action of the giant cells in the bone marrow in a number of pathological conditions. In inoculation, burns, suppuration, after venesection and injections of lecithin and various bacteria, the giant cells take up leucocytes in their interior, a phenomenon which indicates that it may be one of the functions of these cells to destroy leucocytes which have become useless.

Icteric Necrosis of the Liver Cells. Independently of each other, Nauwerck² and Fütterer³ have shown that in obstructive jaundice a thick, yellow or greenish substance occurs in the protoplasm of the liver cells, which, they believe, is bile accumulated in the intracellular biliary channels, studied so well by Eric Müller and others. Fütterer believes that the stagnant bile may be carried off by the lymphatics, as is indicated by Gerhardt's experiments. Fütterer failed to find in his specimens any evidence of an intranuclear network of bile channels as Browicz believes exist. By overdistention of the intracellular biliary channels serious lesions of the protoplasm of the liver cells are produced, leading, finally, to their destruction, which may be called icteric necrosis.

Retrogressive Changes of the Ganglion Cells. Much work has been done upon the finer changes in the ganglion cells as revealed by Nissl's method. In fever the Nissl bodies may disappear, either on account of nutritive disturbances,⁴ or their disappearance may be directly due to the increased temperature.⁵ Poisoning of rabbits with human or bovine blood serum⁶ produces changes similar to those caused by experimental uremia and anemia. Ewing⁷ believes that Nissl's chromophile bodies represent a state of physiological nutrition; hence their disappearance during hibernation. Acute degenerations, such as those produced especially by circulatory disturbances, are evidenced by various forms of solution of the chromophile bodies. Chemical poisons may cause loss of function without demonstrable changes in the cells. On the whole it may be said that as yet none of the various changes described are to be regarded as specific, and that the condition of the cytoplasm proper and of the intermediate substance of the ganglion cells now demands study by new and special methods.

Seagliosi⁸ produced concussion of the rabbit's brain by rapid blows of

¹ *Centralbl. f. allg. Path. u. path. Anat.*, 1898, vol. ix, p. 848.

² *Münch. med. Wochenschrift*, 1897, No. 2.

³ *Medicine*, June and July, 1897.

⁴ Juliusberger and Meyer. *Berl. klin. Wochenschr.*, vol. xxxi, p. 677.

⁵ Goldscheider and Brasch. *Fortshr. der Med.*, 1898, vol. xvii, p. 126.

⁶ Uhlenhuth and Moxter. *Ibid.*, p. 361.

⁷ *New York Medical Journal*, 1898.

⁸ *Virchow's Archiv*, 1898, vol. clii, p. 187.

slight intensity ; the ganglion cells showed various changes, such as swelling, vacuolation, chromatolysis, and varicose atrophy, due, most likely, to nutritive disorders on account of circulatory disturbances.

Experimental Amyloid Degeneration. The experimental production of amyloid degeneration, first accomplished on a large scale by Krakow, has been successfully attempted according to the same general methods by several investigators. The explanations advanced of the origin of amyloid material do not, however, agree.

Petrone¹ produced amyloid degeneration in rabbits by injecting increasing doses of virulent staphylococcus pyogenes aureus. On finding that blood pigment effused into the tissues gives the same color reactions as amyloid substance, he becomes inclined to believe that amyloid degeneration is, in fact, the result of a continuous slight infiltration with blood-pigment into the tissues on account of chronic infection.

Nowak² succeeded in producing amyloid degeneration in some instances by means of staphylococcus and pyocyanus cultures and toxins, and turpentine ; croton oil gave negative results. He points out that there are still many unknown factors and uncertainties in connection with experimental amyloid degeneration.

Maximow³ maintained the virulence of his cultures of staphylococcus pyogenes aureus by continuous transplantation. By gradually increasing the quantity, 20 c.c. could finally be injected into rabbits at one time. The shortest time for amyloid change to appear in the rabbit is twenty-one days ; in the chicken, which is more refractory, two and one-half to three months. Histologically the process consists in the deposition between the elements of the tissue of a peculiar pathological substance. While the exact manner in which this substance is produced is not clear, it may be pointed out that it results when toxic substances, mostly of bacterial origin, circulate in the blood ; as a result metabolism of the cells is probably altered and amyloid material, the final product of this perverse metabolism, is extruded into the intercellular spaces. Hence the more amyloid, the smaller the cells, which finally wholly disappear. This view, Maximow finds, tallies with the morphological appearances, and explains, better than the theory of infiltration, irregularities in the composition and form of the material. Naturally the toxins would act first on the vessel walls, in which the change usually occurs earliest.

It will be seen that the tendency is to look on amyloid degeneration as the result of the action of toxic substances ; it is well to note, however, that pathologists like Ziegler, for instance, still doubt that an actual amyloid degeneration has been produced by experiment.

¹ Recherches sur la dégénérescence amyloïde expérimentale. Arch. de Méd. exp., 1898, vol. x, p. 682.

² Virchow's Archiv, 1893, vol. clii, p. 162.

³ Ibid., p. 354.

Hyaline Bodies. Much has been written of late about the so-called hyaline bodies, which are now generally regarded as identical with Russell's famous fuchsin bodies. These bodies are mostly sharply outlined balls or ovals of varying size, the largest measuring from 20 to 24 mikrons or more in their longest diameter; bottle-shaped and other irregular forms occur, as well as mulberry-shaped conglomerations varying in form, thickness, size, and number of globules. As a rule, these bodies are homogeneous, and when unstained glisten; sometimes with the high power quite a complicated structure may be revealed. Perhaps the best general stain is the Gram-Weigert, which colors them a deep blue; they are also readily stained with the acid fuchsin in Van Gieson's stain and by Russell's special method. When large and fully formed they are more often extracellular than intracellular. Lubarsch¹ has found them in small but inconstant numbers in many tissues otherwise normal, but not in the liver, lung, myocardium, and œsophagus. There is hardly a pathological process in which they have not been observed, being particularly numerous in polypoid adenomatous proliferations of the mucous membrane of the stomach, a favorite field for their study, as emphasized by Hansemann. They are also numerous in actinomycotic lesions and in various morbid conditions of the nasal mucous membrane, where they have recently been studied by Wright;² their frequent occurrence in carcinoma led to their being regarded as "cancer parasites," and some Italian pathologists hold that they are blastomycetes.

A universally applicable explanation of the formation of the hyaline bodies is far from possible at this time. Lubarsch, while not denying that a part of the hyaline bodies may come from capillary and lymphatic thrombi, as claimed by Touton and May, rather regards the majority as cellular products, as does Klien. As shown in Burnmeister's study of experimental bichromate of potassium nephritis, the granules of degenerating cells may coalesce and react as hyaline bodies or become hyaline casts. Lubarsch believes that granular and acidophile cells, usually present where there is breaking up of organic material from any cause, may give rise to hyaline bodies. The process of formation is most likely a form of coagulation with the production of hyalin. As here used hyalin is a collective name, and the chemical nature of the bodies is not considered, although lecithin gives the same reactions.

Thorel,³ who examined twenty stomachs and large and small intestines

¹ Lubarsch and Ostertag's *Ergebnisse*, etc., 1895, vol. ii, p. 180.

² So-called Hyaline Bodies and other Cellular Degenerations in Nasal Polypi. *American Journal of the Medical Sciences*, 1898, vol. cxvi, p. 445.

³ Virchow's *Archiv*, 137.

⁴ Ueber die hyaline Körper der Magen und Darm Schleimhaut. *Virchow's Archiv*, 1898, vol. cli, p. 319.

in regard to the presence of hyaline bodies, finds that the relation between hyaline bodies and acidophile granular cells is quite clear; transition forms are readily seen in thin sections; the cell membrane may rupture and free bodies result while the nucleus disintegrates. The acidophile cells occur in inflammatory conditions and most numerous and constantly in carcinoma of the digestive tract; they may arise *in loco* from wandering cells, mast cells, leucocytes, and fibroblasts. Euschinophile epithelial cells are also common and constant in normal, catarrhal, and atrophic states, and on the whole the origin of hyaline bodies from mesoblastic and epithelial cells receives strong support from Thorel's work.

Wright¹ also assumes a cellular origin for the majority of the bodies in nasal lesions, but Saltykow,² on the contrary, looks upon the large hyaline bodies as formed from hyaline capillary thrombi of red blood-disks, and upon the free and intracellular smaller bodies as being derived from single or coalesced red cells. This latter view is based on the intravascular situation of certain large hyaline bodies observed by him, upon transition stages between red cells and free and intracellular hyaline bodies, as observed in sections stained with Weigert's fibrin method, and finally upon a positive reaction for iron in some of the bodies.

Pelagatti,³ who compared the staining reactions of hyaline bodies with blastomycetes, finding nothing in common between the two, believes that the globular bodies are due to a hyaline degeneration of plasma cells, but there is no direct proof advanced to show that this mode of origin is the general one.

From two cases of yellow fever Klebs⁴ demonstrated certain bodies (principally red, round, oval, or irregular) in the liver and the duodenum by means of the following stain: Parafuchsin kresol solution, 7 parts; concentrated solution of methylene-blue in 5 per cent. solution of borax, 3 parts; 1 per cent. solution of methylene-green, 3 parts; followed by Weigert's aniline oil and xylol mixture.

In the liver, the bodies, of varying size, occurred free as well as within greatly changed leucocytes and liver cells; in some bodies vacuoles and pigment are described. Klebs regards them as protozoa. In the duodenum similar structures were found, associated with foci of inflammation, and circular groups of small round bodies, which stained in the same manner as the larger, were also presented; these "blackberry forms," he suggests, may represent sporulation forms of the "yellow-fever amœba."

¹ Loc. cit.

² Beitrag zur Kenntniss der hyalinen Körper der Magenpolypen und anderen Geweben. Virchow's Archiv, 1898, vol. cliii. p. 207.

³ Virchow's Archiv, 1897, vol. cl. p. 247.

⁴ Anatomic Researches on Yellow Fever. Journal of American Medical Association, April 16, 1898.

Without discussing the revolutionary conclusions as to the prevention of yellow fever drawn from these observations, the great similarity of Klebs's "yellow-fever amoeba" to Russell's fuchsin bodies—*i. e.*, the common hyaline bodies, cannot escape notice. The presence of the common fuchsin bodies in the tissues examined by Klebs does not seem to have been excluded by the use of the standard methods employed in the study of these formations. There is also more or less similarity between Klebs's "yellow-fever amoeba" and the peculiar masses described by Schmaus and Böhm¹ in the liver of white mice and guinea-pigs in experimental phosphorous poisoning. These authors have no doubt that these masses are more or less closely related to Russell's bodies. The masses occurred, in part, within the liver cells, and in some there were vacuoles. Schmaus and Böhm trace the bodies they describe, with great detail, partly to degeneration of leucocytes, partly to liver cells, and also to changed and agglutinated red corpuscles.

Hückel,² in an extensive study of the vaccinated rabbit's cornea, shows that a peculiar degeneration of the protoplasm of the epithelial cells occurs, resulting in the production of many-shaped and curious bodies that have been interpreted as parasitic protozoa by Guarnieri and L. Pfeiffer. Many of these bodies resemble hyaline formations.

Spiller³ reports some observations upon amyloid and other bodies in the central nervous system. In addition to the typical corpora amylacea (corpora versicolorata of Siebert⁴) he describes certain bodies in the tissues of a case of amyotrophic lateral sclerosis, which were round and homogeneous; when partly stained some had a pale centre surrounded by a deeper circle, outside of which was a paler ring; these bodies stained yellow with Lugol's solution and seemed to resemble in many important details the corpora flava of Siebert which, according to the latter author's thorough investigations, come only from direct cellular changes. In a case of cerebral tumor Spiller found irregular concentric masses of varying size which readily stained with a variety of coloring solutions. They occurred in the cortex and in the ependyma, and often had much the same appearance as vessels, to changes in which they are ascribed. In some respects, especially in their staining reactions, these last-mentioned formations correspond to Russell's fuchsin bodies.

Karl Petren⁵ describes the rapid development in large numbers of

¹ Ueber einige Befunde in der Leber bei experimenteller Phosphorvergiftung, etc. Virchow's Archiv, 1898, vol. clii, p. 261.

² Die vaccine Körperchen. II. Supplementheft, Ziegler's Beiträge, 1898.

³ Amyloid, Colloid, Hyaloid, and Granular Bodies in the Central Nervous System. Proceedings Philadelphia Pathological Society, New Series, 1897, vol. i, p. 277.

⁴ Virchow's Archiv, vol. cxxix.

⁵ Ein Fall von akuter Infektionskrankheit mit Thrombosen in den pialen Gefässen des Rückenmarks nebst Beobachtungen über das Verhalten und die Entstehung der Amyloidkörperchen in demselben Falle. Nord. med. Archiv, 1898, No. 2.

homogeneous bodies at the entrance of the posterior roots and in the anterior horns of the lumbar swelling in a case of thrombosis of the vessels of the spinal pia. The bodies stained deeply with alum hæmatoxylin and did not present any lamellation; transition forms showed that these bodies developed from swelling and hyaline changes in the leucocytes and connective-tissue cells; ganglion cells and other nervous structures did not take any part in their formation. These observations would seem to accord well with the conclusion of Lubarsch,¹ that amyloid and related bodies are due to secretive and degenerative cell-changes and closely related to the hyaline bodies. According to origin, we may speak of three kinds of hyaline material as it appears in the masses and smaller bodies above referred to, namely, mesoblastic hyalin, epithelial hyalin, and blood hyalin.

Tissue-cell Embolism. Further observations on embolism of bone marrow are recorded by Lubarsch,² who finds that this dislodgement may occur, without being caused by injury, in rabbits as well as in man. It is observed especially in eclampsia. Lubarsch found that the injection of parenchymatous cells (kidney, testis, and salivary gland cells) leads to secondary embolism of the structures of the bone marrow, which lodge in the lung and eventually disappear. The cause of this embolism is not clear; the injections caused small hemorrhages in the marrow, which, perhaps, loosen its structure and detach small particles.

Foa³ found that the injection of *staphylococcus aureus*, ordinary milk and lecithin, as well as starvation and burns, resulted in the transportation of numerous medullary giant cells to the lungs; this embolism also occurs to some extent under normal conditions.

The ease with which particles of bone marrow are dislodged and floated into the circulation must, therefore, be borne in mind in the diagnosis of strange cells in the pulmonary artery. Megakaryocytes from the marrow must be differentiated from the placental giant cells and syncytial masses which have been found in the lungs and elsewhere in such conditions as puerperal eclampsia. Emboli of tissue cells may induce, on lodging, wide-spread thrombosis from liberation of ferment through degeneration.

Pseudo-melanosis. Ernst⁴ shows that pseudo-melanosis depends on the presence of iron-containing material and bacteria having the power to form H_2S . In an instance of a peculiar dark-green pseudo-melanotic discoloration of the abdominal organs he found extensive siderosis in the discolored areas and a bacillus which rapidly formed H_2S in the cultures.

¹ Loc. cit.

² Virchow's Archiv, vol. cli, p. 546.

³ Centralbl. f. allg. Path. et path. Anatomie, 1898, vol. ix, p. 848.

⁴ Untersuchungen über Pseudomelanose. Virchow's Archiv, 1898, vol. clii, p. 418.

The Relation of Bacteria to Cholelithiasis. The essential role played by bacteria in the production of gall-stones has been strongly brought out by recent studies. The colon bacillus and the typhoid bacillus have become especially prominent in this connection. Gilbert and Fournier¹ divide lithiasis into two groups, the larger due to the colon bacillus, the smaller due to the typhoid. Cushing² has collected four cases from literature, to which he adds two new ones, of post-typhoidal cholecystitis and cholelithiasis, with operation and isolation of the typhoid bacillus; he adds five similar cases with isolation of the colon bacillus. A history of prior typhoid fever is very frequently obtained in cases of gallstone (ten of thirty-one in Halsted's clinic). Cushing also describes an instance of cholecystitis with stones, in which the typhoid bacillus was present though there was no history of previous typhoid. In many of these cases an agglutinative reaction had occurred in the bile. In a case of suppurative cholecystitis operated on by Dr. Bevan, and due apparently to the *staphylococcus aureus*, I found that the bile distinctly agglutinated typhoid bacilli, and the history showed that six years previously the patient had passed through an attack of typhoid fever. Attention is now being directed to the antitoxic and agglutinative qualities added to the bile after various infections.

The sequence of events in post-typhoidal lithiasis, and in the colon group also, is probably, as outlined by Cushing, as follows: The bacilli entering the gall-bladder (as the typhoid bacilli so generally do during typhoid fever, as first shown by Fütterer³) remain alive for quite a long time, during which time an intravesical agglutinative reaction occurs, the clumps forming the nuclei of biliary calculi which, associated with long-lived microbes, may cause cholecystitis at any subsequent period.

The question arises whether the formation of urinary calculi may not have a similar genesis.

INFLAMMATION, REGENERATION, AND OTHER PROGRESSIVE CHANGES.

Inflammation in General. Lubarsch⁴ looks upon inflammation as a combination of tissue alteration with pathological exudation of fluids and cells, and cellular proliferation, in so far as these processes appear to

¹ Lithiase biliaire expérimentale. *Compt.-rend. Soc. de Biol.*, November 5, 1897, p. 936.

² Typhoidal Cholecystitis and Cholelithiasis. Report of a case without previous history of typhoid fever, and discussion of a possible agglutinative reaction in the bile and its relation to stone formation. *Johns Hopkins Hospital Bulletin*, May, 1898, No. 86.

³ Anton and Fütterer. *Münch. med. Wochenschr.*, 1888, No. 19.

⁴ Neuere zur Entzündungslehre. *Deutsche medicin. Wochenschrift*, 1898, Nos. 32 to 35.

constitute an independent disease. In accordance with this attempt at definition, which closely resembles Ziegler's, inflammation may be degenerative, exudative and infiltrative, or proliferative.

The present writer¹ has pointed out that the recognizable tendency, in all inflammatory changes, to protect and repair, fully justifies the teaching that the inflammations are essentially adaptive, protective, and reparative processes; but it cannot escape notice that the protective and reparative tendencies of inflammation are limited and imperfectly controlled, so that the intervention of the physician is often required. Consequently, inflammation from the clinical stand-point may seem harmful, from the pathologic or biologic it is a struggle for preservation.

Fibrinoid Degeneration and the Production of the Fibrinous Exudate. Neumann's theory, that the fibrinous material produced in certain inflammations of serous membranes is not an exudate, but the result of a "fibrinoid degeneration" of the superficial connective tissue of the membrane, has not won much favor, at least so far as the acute non-tubercular fibrinous and sero-fibrinous inflammations are concerned. Careful histological examinations by Gaylord² and others show that the fibrin lies directly upon the cells lining the membrane, at least in the early stages; and that often a thin layer of connective tissue is situated between the fibrin and the elastic layer below which fibrin is not found. This proves that the fibrinous layer is due to exudation. Gaylord's experimental introduction of fibrin into serous cavities also shows that the cell lining remains intact under the fibrin until the progress of organization begins, and that the pleural epithelium has the power to proliferate sufficiently to cover large areas, so that appearances are presented which might be misinterpreted as being due to the formation of fibrin below the epithelium.

Whether a fibrinoid or hyaline (Ziegler) degeneration of connective tissue is responsible for some of the closely adherent fibrinous masses on the pleura over tuberculous pulmonary areas, is still an open question. Its decision seems to hinge upon the relation of the fibrin to the sub-elastic connective tissue.

The Diphtheritic Membrane. Baumgarten³ discusses the histology of the diphtheritic membrane and makes it plain that there is no essential difference between croupous and diphtheritic inflammation. The "diphtheritis" in diphtheria is but the extension of the croupous-membrane-forming process into the deeper layers of the tissue.

¹ Hektoen. *Old and Modern Theories of Inflammation; its Nature and Purpose.* Philadelphia Medical Journal, 1898, vol. ii.

² *Fibrinous Exudates and Fibrinoid Degeneration.* Journal of Exp. Medicine, 1898, vol. iii, p. 1.

³ Berl. klin. Wochenschr., 1897, p. 695.

"Croup" in diphtheria is nothing but a superficial "diphtheritis" of the epithelial layer.

Generally speaking, it would certainly conduce to a better understanding of these pseudo-membranous processes, at least on the part of the student, if the terms croupous and diphtheric, or diphtheritic, were deprived of all anatomical significance and supplanted in this respect by the word fibrinous, which, after all, most clearly describes our knowledge of the nature of the false membrane, no matter whether it is produced by exudation from the blood, by fibrinoid degeneration of the connective tissue (Neumann), or by coagulation necrosis of epithelial cells associated with exudation.

The Cells of the Inflammatory Infiltration—the Plasma Cell.

O. Lubarsch divides the cells of the inflammatory swelling, according to origin, into hæmatogenous wandering cells, histogenic wandering cells, descendants of fixed tissue cells, and descendants of immigrated cells. The relative proportion of these cells varies in the various forms of inflammation, in the stages of the same form, and in different animals, but the immigration of wandering cells is the most prominent feature of many inflammations.

Often combined, there may be accumulation of several sorts of cells in inflammatory products, such as epithelioid, polynuclear, lymphoid, and plasma cells. Recent technical advances make it possible better to distinguish between these different cells, of which the plasma cell of Unna is the last to be singled out as distinct from the others.

In order to understand the present status of the plasma cell and its relation to the other cells, as interpreted by recent writers, it becomes necessary briefly to review its entire history.

In 1891 Unna¹ described the occurrence, in lupus especially, of a peculiar cell which, when stained with old methylene-blue and decolorized with creosote or styrone, presents a deep blue granular cell body of cubic or rhombic form, while the nucleus stains more lightly and often appears as a clear area with a few blue chromatic masses. He distinguished this cell from the metachromatic mast-cell, because he could not find transitional forms, or other connecting links, to show any mutual relationship. On the other hand, he readily satisfied himself that the blue cells come from the connective-tissue cells which enlarge and become rounded, the nucleus staining less intensely, and he concluded that the blue cell was identical with Waldeyer's² plasma cell—a cell in connective tissue so named by the latter investigator on account of the voluminous

¹ Ueber die Plasmazellen, insbesondere beim Lupus. *Monatsschrift f. prakt. Derm.*, 1891, vol. xii.

² Ueber Bindegewebszellen. *Max Schultze Archiv*, vol. xi.

and granular protoplasm. Waldeyer examined Unna's specimens, and at first agreed with him, and so it came about that the blue cell was named plasma cell, a name which it retained after it became known that Waldeyer's plasma cell is of a different nature.

Unna regarded the plasma cell, which occurs freely in the granulations of lupus, as originating from any variety of fixed connective cell and as forming the so-called epithelioid cell of tuberculous proliferations. Having once been formed by the hypertrophy of the connective-tissue cell, a rapid hyperplasia by direct division, ensues, and the new cells have less and less protoplasm; occasionally small multinuclear cells are produced, and then, under the influence of the poison-laden lymph, the plasma cells undergo a peculiar retrogressive homogeneous swelling of the cell body, while the nuclei may persist, and the characteristic giant-cells are formed by coalescence of these degenerated plasma cells. According to Unna, a tubercle is, therefore, an accumulation of degenerated plasma cells, or, as he would have it, a plasmoma.

In his work on *Histopathology of Skin Diseases*, Unna further describes the important rôle of his plasma cell in scar formation and in granulation tissue and in the numerous granulomatous or "plasmomatous" processes (syphilis, rhino-scleroma, actinomyces, leprosy, tuberculosis), with the same general ideas as to its origin and rôle as I have briefly indicated.

In other articles¹ of a controversial nature, the plasma cell is spoken of as a pure pathological product without embryonal analogy.

Before long Jadassohn² confirmed Unna's morphological and tinctorial description of the plasma cell; but, after studying its presence in a number of inflammatory processes of various kinds, he could not identify it with the epithelioid cell nor with Waldeyer's plasma cell, because Unna's cell is really not so granular. As to its origin, Jadassohn found much in favor of its coming from the lymphocytes; at all events, Unna did not prove its derivation from fixed cells.

In the introduction to his important study of the plasma cell, v. Marschalko³ passes in review the familiar notions of the various savans in regard to the nature and the fate of the cells constituting the "inflammatory infiltration," reaching the general conclusion that the progressive development of certain mononuclear leucocytes has not been proved or disproved; leucocytes and connective-tissue cells are all mesodermal, and morphologically certain hematogenous wandering cells cannot be separated from wandering histogenous elements.

Unna's proposition has failed to solve this difficult problem, because his far-reaching and rather startling conclusions lack the needed basis of

¹ Berliner klin. Wochenschrift, 1892, No. 49, and 1893, No. 9.

² Vesh. d. deutsch. Derm. Ges., Leipzig, 1894, and Berl. klin. Wochenschrift, 1893.

³ Ueber die sogenannten Plasmazellen. Archiv f. Dermat. u. Syph., 1895.

fact; but credit is due to him for the discovery of the methylene-blue reaction of the chromatin and spongioplasm of the plasma cell. Perhaps even more important than the tinctorial characteristics of this cell are the practically constant eccentric position of its nucleus and the crumbling into balls (*zusammengeballung*) of its protoplasm, which is, in reality, not granular, and which stains more deeply at the periphery than around the nucleus. (Plate III., Fig. 2.)

Clearly not related to the epithelioid and typical young connective-tissue cells, v. Marschalko studied the plasma cell in experimental lesions made by injecting one or two drops of carbolic acid into the liver of rabbits and dogs. In twenty-four hours leucocytes gather in large numbers, and at the outskirts of the cell-mass occur many lymphocytes, some of them in the act of passing through the vessel wall, and outside the lymphocytes plasma cells appear. He makes a drawing illustrating the transformation of the lymphocytes into plasma cells. Later, connective-tissue proliferation takes place, and on the seventh day the plasma cells, which have increased in numbers, become less numerous and change their form; it is not clear whether this is due to the pressure of the fibroblasts or to progressive development. Their final fate remains unknown. The number of mitoses observed is not in proportion to the large number of connective-tissue cells—a fact which may speak in favor of the further development of plasma cells.

In the spleen and in the lymph-glands of the normal rabbit, v. Marschalko found cells that were like plasma cells in all details except that the protoplasm stains less deeply; the same cells were found in the normal human spleen; in the human lymph-glands more deeply stained cells were found; in the spleen and lymph-glands of white rats and mice he found typical plasma cells in large numbers. Artificial leucocytosis, produced by the injection of tuberculin, enabled him to demonstrate the presence of typical plasma cells in the lumen of the splenic vessels.

Finally, he demonstrated the presence of plasma cells in a large number of pathological products, including the "round-cell infiltration" about malignant tumors. In leprosy he could not find bacilli in plasma cells, and he makes no mention of ever having seen any signs of phagocytic action on their part.

He concludes that, gifted with great stability, the plasma cell undoubtedly plays an important part in inflammatory reactions; it occurs in injuries to connective tissue and epithelium, whether of mechanical or infectious nature, and forms a protective wall preventing the spread of the morbid process into the healthy tissue.

In 1895 Waldeyer publicly withdraws the term "plasma cells" first used by him to designate certain granular, perivascular cells, because some correspond to Ehrlich's mast-cells, while other superficially similar

cells in the adrenals, the corpus luteum, and the sacral gland, are of totally different nature, and, on the other hand, Unna's plasma cells are distinct and separate from all these cells.

Among the cells of the connective tissue of epithelial tumors, Cajal¹ describes certain cyanophile cells (cells with basophile protoplasm) as of constant occurrence; these cells are identical with Unna's plasma cells; they form the principal part of chronic inflammatory infiltrations, and are regarded, on the one hand, as identical with the much-discussed mononuclear leucocytes or lymphocytes of some authors, while others regard them as embryonal connective-tissue cells produced either from the capillary endothelium or from fixed connective-tissue cells. Cajal, on the contrary, derives these cells from mesoblastic germinal corpuscles (*corpúsculos germinales*) which lie in the lymph-spaces and, most numerously, in the lymph-glands whose cells for the most part are such corpuscles. From these undifferentiated elements the various formative cells (fibroblasts, osteoblasts, leucoblasts, erythroblasts, etc.) develop.

Hodara² studied the spleen, lymph-glands, and bone-marrow of twelve normal individuals, varying in age from a three-months' fetus to thirty-three years, for the purpose of solving the problem as to whether plasma cells are normally present in the organs or not. By means of standard technical methods he found that among the large mononuclear leucocytes, which he describes at great length, occasional cells may occur under normal conditions, which answer in some but not in all respects to the plasma cells. These he calls pseudo-plasma cells. He found typical plasma cells in the organs of a seven-and-a-half-months fetus and of a one-year-old child, but here it concerned pathological tissues. He is inclined to believe that v. Marschalko may have mistaken the false plasma cells for true; that the plasma cell is, as Unna believes, a purely pathological product.

According to Schottländer,³ the lymphocytes and mononuclear leucocytes become plasma cells on account of some change in the protoplasm of a progressive character. He finds definite transition forms between plasma cells and connective-tissue cells, as well as the epithelioid cell of tuberculous proliferations; the latter cells he regards as being formed by a degenerative process in the plasma cell. Schottländer found plasma cells in the normal broad ligament, and looks upon it as of physiological occurrence.

¹ *Histologische Studien über die epithelialen Geschwülste*, Ramon y Cajal. Monatshefte für prakt. Dermatologie, 1896, vol. xxiii. p. 548. Abstracted from Rivista trimestrale micrografica, B. I. H. 2 and 3, August, 1896.

² *Y a-t-il des cellules plasmatiques (Plasma-zellen) dans les organes hématopoiétiques normaux de l'homme? Contribution à l'étude des grands leucocytes mononucléaires.* Annales de Dermatologie et de Syphiligraphie, 1896, vol. vi. p. 856.

³ *Ueber Fierstockstuberkuöse*, Jena. (Quoted by Krompecher, loc. cit.)

Krompecher,¹ in his study of the plasma cell, refers to the perinuclear clear space, the eccentric position of the nucleus, and the five to eight coarse chromatic particles arranged on the inner surface of the nuclear membrane, as forming, together with the blue stain of the protoplasm, the chief characteristics of this cell. This author did not notice mitosis in the plasma cell, as it occurs in various forms of inflammatory and granulation tissue and in tumors, but mentions an amitotic form of division when the nucleus, retaining the mural arrangement of the chromatin particles, becomes kidney-shaped owing to a one-sided constriction. In chronic inflammatory areas one usually finds a layer of leucocytes around the vessels, and between this layer and the connective tissue greater or smaller numbers of plasma cells with numerous transition forms between these and the lymphocytes; some plasma cells also come, he finds, from polymorphonuclear and mononuclear leucocytes. The plasma cells may vary much in size, some being real giants, and there may be more than one nucleus. In the simpler forms of inflammatory proliferations, normal or typical plasma cells predominate, but in tuberculosis, syphilis, actinomycosis, etc., various changes are seen. The nucleus may be diffusely stained, the chromatin network faint, with one or two central, deeply stained bodies which resemble nuclei, and the nuclear outlines may be indistinct; at the same time the protoplasm is often scaly, broken up with irregular contours, and occasionally distinct vacuoles may be found. Krompecher regards such cells as presenting retrogressive changes. In certain tumors (carcinoma of the breast and endothelioma of the skin) cells were found that contained fine basophile granulations, filling the cell-body completely, and assuming a cherry-red color with polychrome methylene-blue—*i. e.*, metachromatic—yet the nucleus had the position and appearance of plasma cells; hence Krompecher calls such cells “plasma-mastzellen.” In some tumors characteristic hyaline or fuchsin bodies occurred in plasma cells. In tumors, and especially in tuberculosis, the nuclei of the plasma cells may undergo karyorhexis, accompanied with hyperchromatosis.

Krompecher is fully convinced that plasma cells may change to connective-tissue cells. In the first place, he found, as did Schottländer, transition stages between the two cells; transitional pictures do not, however suggestive, constitute certain proof, and consequently he places greater stress on finding groups of parallel cells (consisting of a long, narrow, protoplasm which stains like that of plasma cells) which have distinct collagenous fibrillar processes; the main conclusion arrived at is that plasma cells represent transition forms, of hematogenous wandering cells, into connective-tissue cells.

¹ Beiträge zur Lehre von den Plasmazellen. Ziegler's Beiträge, 1898, vol. xxiv, p. 163.

Karl Justi¹ believes that plasma cells develop from small leucocytes with round nuclei; this identity is demonstrated by staining suitable sections, first with hæmatoxylin and then with polychrome methylene-blue, when certain cells will show the nucleus of leucocytes and the protoplasm of plasma cells. He thinks that methylene-blue is attracted to the protoplasm by the presence of certain substances in it, which the cells transport and, perhaps, in that way remove from the tissue, and that the nucleus enlarges preparatory to amitotic division.

The various types of leucocytes are members, as developed by Heidenhain, of the same group of cells; in granulating wounds polynuclear cells migrate to the surface, while the deep layers contain many cells with round nuclei, to which class the plasma cells belong; all leucocytes, including the plasma cells, are easily distinguishable from formative cells with vesicular nuclei, but hyperchromatic, hypoprotoplasmic, embryonal cells may be difficult to recognize as such. Leucocytes and plasma cells do not form collagenous substances, and plasma cells do not change into the epithelioid cells of tuberculous tissue, as claimed by Unna. Justi finds that leucocytes may become larger in the tissues than in the blood, an observation which may explain the variations in the size of the plasma cells.

Councilman's² valuable study of the interstitial nephritis of scarlet fever and other infectious diseases has brought to light many new and important features of the plasma cell. Heretofore its sphere had seemed somewhat circumscribed, being confined largely to the granulomatous processes, but Councilman shows that it forms the essential element of the extensive cell infiltration of this form of nephritis, a process of different pathogenesis from most of those that the plasma cell has previously been associated with.

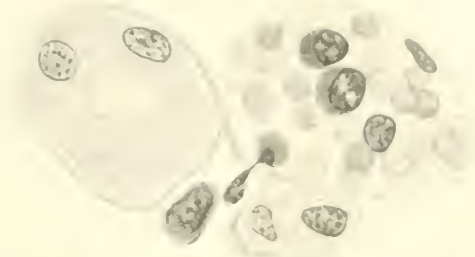
In the acute interstitial nephritis of Councilman the tubules are widely separated by infiltration in the interstitial tissue, and often this is more marked beneath the capsule at the base of the pyramids and around the glomeruli. The cells, which form by far the larger part of the infiltration, are generally larger than the polymorphonuclear leucocytes; the nucleus is eccentric, never vesicular; the membrane is deeply stained with projecting points on the inner surface, from which a network passes to large chromatic masses in the interior; the nuclei vary in number from one to three, the majority of the cells being uninuclear. The cells vary in shape, depending on the conditions of pressure; when single they are round; the cytoplasm is dense, often finely granular, and the contour irregular, a fact which Councilman ascribes to amœboid movement,

¹ Ueber die Unna'schen Plasmazellen in normalen und tuberkulösen Granulationen. *Virchow's Archiv*, 1897, vol. cl.

² Acute Interstitial Nephritis. *Trans. Assoc. of Amer. Physicians*, 1898, vol. xiii, p. 399, and *Journ. of Exper. Medicine*, 1898, vol. iii, p. 393.

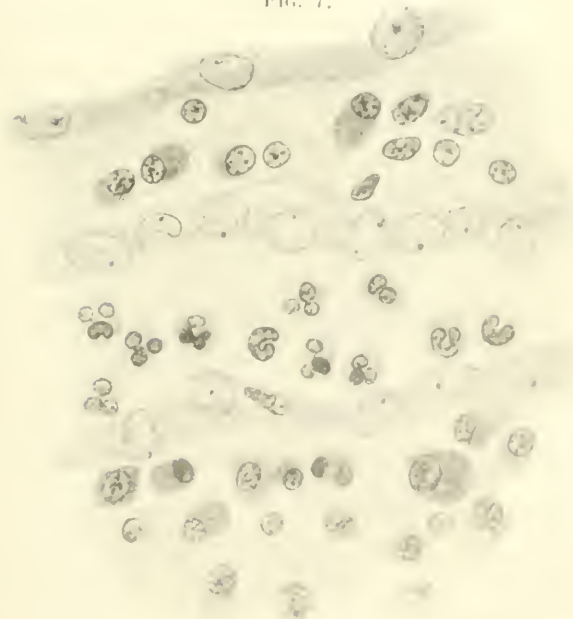
and the plasma stains with methylene-blue. Nuclear figures are mitacrous in the cells, with granular, blue cytoplasm—an important observation not before recorded by the authors of works on the plasma cell. Such cells are also present in the bloodvessels, though not in the tubules, and they do not manifest any phagocytic properties.

FIG. 6.



Emigration of plasma cells from a small vein. (COUNCILMAN.)

FIG. 7.



Plasma cells in the interstitial tissue between the renal tubules. (COUNCILMAN.)

Councilman believes that these cells are lymphocytes, which migrate as such or as plasma cells from the blood; facts in favor of migration are the irregularities in outline and the observation of cells in the act of passing through the vessel wall; having reached the interstitial tissue, rapid multiplication may take place. He found them in great numbers

in the spleen and bone-marrow, also in the lungs, liver, capillaries, and lymph-glands; in the alimentary tract all cells from the stomach to the anus, between the epithelium and the muscularis mucosæ, are practically plasma cells; the principal seat of formation, however, is in the pulp and Malpighian bodies of the spleen. (Figs. 6 and 7.)

Inasmuch as the presence of bacteria bears no relation to the interstitial infiltration, this accumulation of plasma cells, in the kidney, is referred by Councilman either to mechanical causes—slowness of the circulation in certain parts of the kidney—or to chemotaxis, the cells accumulating where the urinary secretion is most toxic, a view advanced by Ribbert as explaining the focal nature of inflammations in the kidney. Councilman advances no opinion in regard to the fate of the plasma cells in the kidney, and the only evidence of degeneration which he observed was the presence of vacuoles.

While it is practically accepted, by all but Unna, that the plasma cell is of hæmatogenous origin, and is derived more particularly from the basophile group of leucocytes (small and large lymphocytes, etc.), yet its relation to the new-formed tissue is as yet a little vague. Its power to form new connective tissue is neither proved nor disproved, although the weight of opinion is rather in favor of the affirmative. Practically, however, our knowledge of the formation of new connective tissue in inflammatory and other processes remains about the same as before the advent of the plasma cell; it is formed chiefly by the fixed, the endothelial, and the histogenic wandering cells, but the participation of certain hæmatogenous wandering cells in this process is not settled (Lubarsch).

Among the interesting questions raised by these studies of the plasma cell, such as its origin, function, and fate in inflammation, the observations of Councilman on its origin from intravascular or emigrated lymphocytes and on the power of amoeboid movement of the latter group of cells are especially noteworthy. It may be regarded, as hitherto currently accepted, that the typical lymphocyte is an immotile cell. Jolly,¹ however, finds that in the batrachian lymph this cell is capable of pushing out pseudopods, and that the different forms of leucocytes are members of the same family, because, in spite of morphological differences, amoeboid activity, a fundamental physiological property, is in the end common to all. By many, lymphocytes are regarded as the larval form of leucocytes, and Sherrington and others believe that they may develop into the amoeboid and phagocytic hyaline cells (the large cell of Kantlack and Hardy with a round or kidney-shaped nucleus, which has slight staining power).

¹ Recherches sur la valeur morphologique et la signification des différents types de globules blancs. Arch. de Méd. Exp., 1898, vol. x.

Granting, with Councilman and Welch,¹ that the lymphoid cells may emigrate as well as the polynuclear leucocytes, and that the accumulation of plasma cells in certain inflammations is not the result of multiplication *in loco* of lymphocytes and plasma cells mechanically forced out of the blood, there is seen here another striking example of the selective action of different kinds of chemotactic stimuli, part of which influences the migration of lymphoid and plasma cells, part that of other leucocytes.

All authors so far agree that the plasma cell is not phagocytic. In the acute interstitial nephritis of Councilman it was not evident that the infiltration of plasma cells bears any relation to bacteria; the idea naturally presents itself that the accumulation of this cell may, however, be closely connected with the presence of toxins upon which the plasma cell may exercise some neutralizing or destructive influence. Questions like these, as well as others, such as that of the fate of the plasma cell, concerning which it was found that the authors are not agreed, require further study.

The technic of staining plasma cells is simple. Tissues may be fixed in alcohol, corrosive sublimate, or Zenker's fluid; stained by Unna's polychrome methylene-blue, Unna's alkaline methylene-blue, or in thionine; decolorized in glycerin-ether mixture, alcohol, or 0.25 per cent. alcoholic neutral orcein solution, and cleared in oil of bergamot. Councilman recommends staining deeply with eosin first, following this by Unna's alkaline methylene-blue, a method which, after some practice, yields excellent results with tissues fixed in Zenker's fluid.

The Fate of the Multinucleated Giant Cell. The fate of the multinucleated giant cells, which form in many specific processes as well as around foreign bodies, has been studied by Hektoen.² In an unusual and interesting case of healing tuberculous meningitis, of four months' standing, the newly formed inflammatory tissue contained many giant cells, some of which were disintegrating, while others presented more or less well-marked evidences of progressive changes and separation into minnuclear living cells. The conclusion is drawn that in healing non-degenerative tuberculous tissue the multinuclear giant cells may again form viable cells, a fact which would tend to show that the giant cells of tuberculosis are not, as claimed by Baumgarten, Weigert, and others, necrobiotic elements which are doomed to destruction from their very inception, but are, rather, as urged by Metschnikoff, the result of defensive or adaptive changes in the organism. When the conditions which lead to their formation are removed, the giant cells may retain enough irritability to form a number of living cells. This view is supported by observations

¹ Discussion of Councilman's paper, *loc. cit.*

² The Fate of the Giant Cells in Healing Tuberculous Tissue, as Observed in a Case of Healing Tuberculous Meningitis. *Journal of Experimental Medicine*, 1898, vol. iii. p. 21.

on the changes that occur in the absorption of solidified blood-serum inserted in the anterior chamber of the rabbit's eye. At the same time as the serum is absorbed, largely by intracellular digestion, a new fibrous tissue forms, in which are giant cells. In the later stages the new tissue, situated on the posterior elastic lamina, assumes a cornea-like structure; the protoplasm of the giant cells, which are free from retrogressive changes, becomes more dense, lines of cleavage appear, mapping out uninuclear cells which gradually are sundered from the main mass, and the protoplasm apparently proceeds to take part in the building up of the new tissue, a fact which would point to the cells covering Descemet's membrane, or to their descendants, as being the original source of the giant cells in this process.

The Power of Epithelial Cells to Live Outside the Body, and Epithelial Regeneration. Observations bearing upon the power of cells, especially epithelial, to maintain their vitality outside the body are beginning to multiply. Ljunggren¹ preserved carefully sterilized bits of human skin in sterile ascitic fluid. He was greatly surprised to find that even for as long as three months the cells of the deeper layers showed well-stained nuclei and good protoplasmic structure. Successful transplantation was made with pieces kept in sterile fluid for one month. Small pieces of the transplanted skin were removed, at varying intervals, under conditions which absolutely prevented the cells of the cutaneous margin of the denuded area from becoming mixed with those of the foreign piece (which had been placed in the centre of a large muscular surface 10 cm. away from the old skin); it was found that a marked proliferation of epithelial cells which showed many nuclear figures had occurred; the transplanted cells not only grew over the raw surface, but penetrated also into the granulation tissue after the manner of a beginning carcinoma.

More extensive and diversified experiments are needed to throw full light upon the interesting biological problems involved in these observations.

Among the many interesting observations of Leo Loeb on epithelial regeneration,² the following are especially worthy of notice: From the margins of the defect huge epithelial protoplasmic or plasmodial masses move in a sliding manner over the naked surface, inclosing and dissolving the crust and other obstacles. Regenerating epithelium readily removes such substances as cartilage when placed in its way. Below the protoplasmic layer epithelial cells wander in from the margins of the defect, and often grow down into the connective tissue, apparently

¹ Om. hudepitelets förmåga utåfor människoorganismen kunna bibehålla lifvet. Nordiskt Medicinskt Arkiv, 1898, Haft 2.

² Ueber Regeneration des Epithels. Arch. f. Entwicklungsmechanik der Organismen, 1898, vol. vi. p. 296.

checking the growth of the latter. The process is closely allied to the changes in carcinoma. At the same time active changes, such as mitoses, occur in the epithelial cells removed some distance from the margins of the wound. The position formerly occupied in the epidermis by the cells which pass out into the defect has nothing to do with the ultimate place the cells come to occupy in the new tissue. When the advancing epithelium meets resistant obstructions, such as hair follicles, small cysts may form by the fusing of epithelial masses which advance around the obstacle and meet. When groups of epithelial cells become separated from the epithelial layer proper, they may form giant cells of the Langhans type, by a process of fusion and disappearance of the nuclei in the centre, because the nuclei are nourished the poorest; such giant cells differ from the plasmodial masses, first described, in that they undergo complete necrobiosis. Giant cells are also formed by nuclear division and failure of the cell-body to divide. Loeb believes that the wandering of the cells, as outlined, is in response to stereotropism, and forms a determining factor in inducing mitosis in the remaining cells. Amitotic division is also observed, especially in the middle and upper Malpighian layers. The exact cause of this mode of cell division is not clear. If a small bit of epithelium is placed in the centre of the crust covering a defect in the skin, it begins to send out processes in all directions into the crust, the cells acting as separate organisms independent of blood-supply or nervous influences.

Healing of Wounds of the Brain and Regeneration of Nerves.

According to Jschistowitsch,¹ the healing of aseptic wounds in the brain is accomplished principally by the connective-tissue elements of the pia and of the vessels; the part which the neuroglia plays is limited, and consists in the building of a secondary sclerotic zone about the scar or foreign body, and this occurs only when the irritation is prolonged and strong. It is not denied that in gradual destruction of brain elements the hyperplasia of the glia may be more pronounced. Regeneration of ganglion cells is wholly absent.

Wieting² finds that the new axis cylinder, in regeneration of peripheral nerves, may develop from the protoplasm of the cells of Schwann's sheath, and later coalesce with the old axis cylinder. Hitherto the general view has been that an outgrowth of the old axis cylinder takes place, which certainly harmonizes better with the present conception of the neuron as an anatomical, functional, and nutritive unit.

Eosinophilia in Trichinosis. The accurate study of the blood in trichinosis, published from the medical clinic of Johns Hopkins Hospital

¹ Ueber die Heilung aseptischer traumatischer Gehirnverletzungen. Ziegler's Beiträge, 1898, vol. xxiii. p. 320.

² Ziegler's Beiträge, 1898, vol. xxii. p. 43.

by Thomas R. Brown,¹ brought out the remarkable fact that the eosinophiles undergo a marked increase, reaching 35 per cent. more than ever before reported, associated with a marked fall in the neutrophiles. Brown is inclined to believe that the eosinophiles are formed in the affected muscles from the neutrophilic leucocytes. The trichinae, reaching the muscles, produce certain tissue changes and also chemotactic substances which attract polymorphonuclear leucocytes, these latter emigrating and taking up degenerated bits of muscle at the same time that changes in the nature of the protoplasmic granules are produced, resulting in the production of eosinophile cells which wander back into the circulating blood. In addition to the value of this study from the stand-point of diagnosis, it also brings into the foreground an interesting question in regard to the as yet obscure factors which lead to local accumulations of eosinophilic leucocytes in certain skin affections, carcinoma, etc.

TUMORS.

Histogenesis. From the comprehensive review by Hauser,² of the more important work on carcinoma that appeared between 1891 and 1897 inclusive, as well as from the recent literature on other forms of tumors, it becomes very clear that a generally applicable explanation of tumor-growth cannot yet be made. The conditions vary not only for the different forms of tumors, but also for individual cases of the same type. Thus the histogenetic studies of Ribbert on the one side and Hauser on the other, seem to indicate that the acquired or inherited tendencies of certain cells and cell-groups to increased formative activity and the production of atypical tissue (carcinoma) are in many cases stimulated by changes in the neighborhood of the cells in question (Ribbert), in other cases by cell displacement, and, finally, there is much to indicate that the most important factor to be considered is a fundamental change in the biologic properties of the epithelial cell (Hauser). Hanseemann's observations, that the mitotic figures of carcinoma and other tumor cells are different from those of normal cells, have been interpreted as signifying a radical change in the character of the cells forming the tumor, which manifests itself in an abnormal power to exist and to grow in an independent, almost parasitic, manner.

In a discussion³ of Montgomery's case of teratoma of the abdominal cavity, Barker points out that teratomas, though of early embryonic origin,

¹ Trichinosis, with Especial Reference to the Increase and Origin of the Eosinophilic Cell. *Journal of Experimental Medicine*, May, 1898.

² *Centralbl. f. allg. Path. u. path. Anat.*, 1898, vol. ix, p. 221.

³ *Journal of Experimental Medicine*, 1898, vol. iii, p. 284.

may appear at almost any period of life; that they may contain tissues far removed from the normal type; that their growth and termination vary exceedingly, and, finally, that metastasis occurs in certain instances—facts which taken together lend support, in a striking way, to the doctrine of Cohnheim in regard to the origin of tumors in general.

Cohnheim's theory is also strengthened by the frequent development of tumors from the remnants of fetal structures, such as Gärtner's duct, etc., in various parts of the body.

The Theory of the Infectious Origin of Malignant Tumors.

The theory of the infectious nature of certain tumors, especially the malignant, is still championed by Italian pathologists, more particularly by Sanfelice and Roncali. Their publications deal exclusively with certain organisms which they place among the blastomyces, a familiar example of which is the ordinary yeast plant. They regard the organisms which they have isolated in pure culture from tumors in the human being, and to some extent successfully reinoculated into animals, as identical, or at least largely so, with the various bodies long observed in malignant tumors, and variously interpreted as protozoa and later as cellular degeneration products, as cell inclusions, and as artefacts of various kinds. A common name for a large part of these bodies is Russell's fuchsin bodies; they are not, by the majority of pathologists, regarded as of etiological significance. Francesco Sanfelice¹ attaches little weight to the now general interpretation that Russell's fuchsin bodies are products of degeneration or secretion and not of parasitic nature, because no thorough observations have been made upon the appearance in the tissues, when subjected to the staining methods employed to demonstrate the hyaline bodies, of known pathogenic blastomyces. Pelagatti, for instance, in his comparative study of the staining reactions of blastomyces and hyaline bodies, from which he concluded that they have nothing to do with each other, used only cultures of blastomyces. Sanfelice points out that a blastomyces organism may react quite differently after it has remained in the tissues for a time than when in artificial culture; blastomyces vary considerably in different animals; in the dog they may, to a certain extent, assume the form of typical fuchsin bodies; the inoculation of pure cultures of *saccharomyces neoformans* into cats invariably produced, in Sanfelice's hands, characteristic hyaline bodies, as demonstrated by the use of many different but appropriate staining methods. They are well illustrated in the plate accompanying the article. Such bodies do not occur in the tissues of normal cats. Sanfelice concludes that these bodies are the identical blastomyces injected,

¹ Ueber die experimentelle Erzeugung der Russell'schen Fuchsin-körperchen. *Centralbl. f. Bakt., etc.*, Abth. 1, 1898, vol. xxiii. p. 276.

which assume in the tissues the form of Russell's bodies, a conclusion which is hardly justified as long as it is not proved that the resulting tissue changes did not produce the bodies in question by processes of degeneration or secretion.

D. B. Roncali¹ states that the existence of blastomycetes in malignant tumors may be regarded as certain and irrefutable; they are constantly present in degenerated and non-degenerated forms; they are to be found in the recent, peripheral parts of the tumors, but it may require hundreds of sections to demonstrate their presence; they are similar to the cancer parasite or coccidia of previous authors. On account of their tendency to swell up, coalesce, and then calcify with the formation of striae, one variety has been called by Sanfelice the *saccharomyces lithogenes*.

Sanfelice² passed a blastomycete, isolated by him from cases of carcinoma in man, and which he calls the *saccharomyces neoformans*, through several dogs. By further inoculations he obtained two positive results. In one case a typical adenocarcinoma, with lymphatic metastasis, developed in the region of the hind nipples in a female dog; the development of the neoplastic process began a little more than a month after the inoculation, the animal dying from marked cachexia ten months later. In the second case an equally typical adenocarcinoma of the testicles, with numerous secondary masses in the vicinity, followed injection of *saccharomyces neoformans* into the testes; the tumor first showed itself one and a half months after the injection, death resulting in about six months. In these new-growths the parasites appeared in the tissues as numerous extracellular and intracellular fuchsin bodies. Further experiments were made with materials from these animals, the results of which are to be reported later.

D. B. Roncali³ publishes a case from Durante's surgical clinic in Rome, the anatomical nature of which is sufficiently indicated in the title of his paper. The growth was removed from a woman, forty-eight years old, and together with 35 cm. of the resected colon, it weighed 2900 grammes; histologically the structure corresponded to that of an adenocarcinoma, but the sections showed, further, the presence in enormous numbers of peculiar bodies which Roncali regards as blastomycetic organisms, in various stages of calcareous infiltration resulting eventually in the forma-

¹ On the Existence of Blastomycetes in Adeno-carcinomata and Sarcomata, and the Peculiar Processes of their Degeneration in Neoplastic Tissue. *Journal of Pathology and Bacteriology*, 1898, vol. v. p. 1.

² Ein weiterer Beitrag zur Aetiologie der bösartigen Geschwülste. *Centralbl. f. Bakt., etc.*, Abth. 1, 1898, p. 155.

³ Klinische Beobachtungen und histologische und mikrobiotische Untersuchungen über einen Fall von primärem Adenocarcinom (Papilloma infectans) des Colon transversum und descendens mit secundärem Uebergang auf das grosse Netz und das Mesenterium. *Centralbl. f. Bakt., etc.*, Abth. 1, 1898, vol. xxiv. p. 61.

tion of concentric calcareous masses. Cultures were made on sixty tubes containing distilled water, with grape sugar and "an acid," as recommended by Sanfelice; after from eight to ten days' sojourn in the incubator, forty-seven of these showed a whitish film composed of large, round, or oval cells, surrounded by a thin refracting membrane and containing a homogeneous protoplasm with from one to five or more shining granules. Many of these organisms presented buds, others longer processes like hyphæ. The organism grew well on various media. Injected into the abdomen of guinea-pigs the cultures were followed by the development of nodules in the various organs and tissues, the nodules being composed of a newly formed granulation tissue, and containing numerous bodies like those found in the primary growth.

The organism isolated corresponds to the one already described by Roncali in a carcinoma of the tongue and in the axillary metastasis of a sarcoma of the mammary gland, and called *blastomyces vitro simili degenerans*. Roncali regards this *blastomyces* as the cause of the primary growth.

In view of the results of the animal experiments, it would seem that they concern proliferations which as yet have to be regarded as inflammatory in their nature, and that such cases as this of Roncali's would tend to widen our views of the pathogenic possibilities of the *blastomyces*, which future observations will undoubtedly enlarge still further. The studies of a few American investigators, the pioneer being Gilchrist, have already served to emphasize the importance of the blastomycetic inflammatory processes of the skin.

Recent literature does not contain any studies which confirm or seriously criticise the no longer novel claims of Sanfelice, Roncali, and others, and these investigators have not found it necessary to change their views. Park¹ finds the work of the Italian pathologists creditable and convincing. It is to be expected that the recently inaugurated New York State Pathological Laboratory in Buffalo, the special mission of which is to investigate tumors, will soon issue reports containing the results of painstaking researches in this line. If the *blastomyces* occur in Italy, as they seem to do, in growths now ordinarily regarded as true tumors, it will only be a question of time before similar observations are made elsewhere. It is hardly reasonable to assume that the occurrence of *blastomyces* in tumors should be indigenous to Italy.

Osseous Metastasis in Relation to Carcinoma of the Thyroid and Prostate; Metastasis Due to Retrograde Transport. The great frequency with which malignant tumors of the thyroid, especially carcinoma,

¹ An Inquiry into the Etiology of Cancer. American Journal of the Medical Sciences, 1898, vol. cxvi, p. 503.

form metastases in bone, is well shown by Limmacher,¹ who analyzed 7461 post-mortem records in the Pathological Institute of Berne; there were 38 cases of carcinoma of the thyroid, and of these 35 had given rise to metastases, of which 14 involved bones, the skull, sternum, and ribs being the most frequent seat; there were 44 cases of sarcoma of the thyroid, and 35 had formed metastases, of which 8 involved the bones.

Comparison showed that of carcinomas of the stomach, 0.9 per cent. formed metastases in the bones; of the œsophagus, 2.2 per cent.; of the uterus, 5.7 per cent.; and of the thyroid, 36.9 per cent.

The relation of carcinomatous growths in bone to primary foci in the prostate and in the thyroid, is emphasized by Cone² in connection with the description of a case of prostatic carcinoma.

In searching for the primary source of osseous carcinoma it is to be remembered that the original tumor, in the prostate or thyroid for instance, may be very small, and that cases have been described by Friedland and others in which the primary carcinoma was a diffuse and infiltrating growth which had led to atrophy of the thyroid.

Witte³ records an instance of retrogressive lymphatic transport of tumor cells from a carcinoma of the stomach, leading to multiple carcinomatous constrictions of the ileum.

Many metastases commonly regarded as due to implantation of tumor particles on free surfaces are often due to backward transport in the veins or lymphatics, as has been shown by Kaufmann to be the case in the so-called implantation-metastasis of the vagina, in carcinoma of the uterus.

In a case of angiosarcoma of the left kidney, with tumor thrombosis of the renal veins and the vena cava, and metastases in the liver, lungs, and myocardium, Ernst⁴ found a tumor embolus in one of the coronary veins (vena cordis media) as the undoubted result of a backward transport. A somewhat similar instance has been described by Bonome. In Ernst's case it concerned an obstructing plug, which was large enough to even dilate the vein, and hence must have been driven in with some degree of force, a fact which speaks in favor of Arnold's view that there may be an actual reversal of the current, and against Ribbert's view of a slow creeping along the wall on account of momentary backflow during each auricular contraction, there being no valves between the auricles and the vena cava.

Chorionic Epithelioma. The contributions to the study of chorio-epithelial tumors (deciduoma malignum, syncytioma, etc.) are rapidly

¹ Virchow's Archiv, vol. cli., Supplementheft, 1898, p. 146.

² Johns Hopkins Hospital Bulletin, 1898, vol. ix, p. 114.

³ Philadelphia Medical Journal, May 7, 1898.

⁴ Ueber rückläufigen Transport von Geschwülsttheilen in Herz und Lebervenen. Virchow's Archiv, 1898, vol. cli, p. 69.

increasing. The pronounced malignity which this tumor may assume emphasizes the great importance of an early diagnosis and of a clear idea of the present knowledge of the subject.

Veit¹ still adheres to his theory that in "myxoma chorii," as well as in "deciduoma," the primary seat of the disease is in the uterus. "Myxoma chorii," he claims, results from a round-cell infiltration of the decidua vera and serotina, due to a primary process in the endometrium. "Deciduoma," he contends, concerns a sarcoma of the endometrium; under the influence of pregnancy the cells of the tumor become more syncytial or decidual in appearance; at the same time changed fetal elements, such as chorionic epithelium and villi, may enter the maternal vessels and form emboli, which have not the power, however, to form metastases; genuine metastases occur only when the sarcomatous elements are transported.

This view does not seem to have found many supporters. Ruge emphasizes that the primary process is situated in the ovum and that Veit's sarcoma cells are syncytial masses. Offspring of the syncytium may invade the uterine mucosa and remain alive for some time after the expulsion of the ovum or mole, especially if chorionic villi are also left behind, and yet progressive invasion of the muscularis may fail to take place. There must be recognized a benign as well as malignant syncytial tumor growth.

Durante² points out that the first and most constant changes in the formation of the so-called mole are swelling and mucoid degeneration of the syncytium; the accumulation of mucus in the mesodermal structures is secondary, and proliferation of the cells of Langhans's layer, which generally occurs, may be absent. The swelling and proliferation of the epithelial covering, which retains its normal relations to the mesoderm, makes this tumor present certain analogies to adenoma; on the other hand, when syncytial masses and epithelial cells penetrate into the maternal tissues and bloodvessels, the benign tumor has changed into a carcinoma.

F. Marchand³ reviews the literature since 1895, and shows that the theory of the epithelial nature of these tumors, brought forward by him in that year, has only been strengthened by subsequent publications. As to "myxoma chorii," Marchand finds that mere examination of the mole is not sufficient to demonstrate its benign or malignant character. An apparently benign mole may give rise to metastases, and, on the other hand, transported villi may fail to give rise to new growths; the behavior

¹ Zeitschrift f. Geburtshilfe, etc., 1898.

² Variétés histologiques et nature de la mole hydatiforme. Arch. de Méd. Expériment., 1898, vol. x.

³ Ueber das maligne Chorion-epitheliom. Zeitschrift f. Geburtshilfe, etc., 1898, vol. xxxix. p. 174.

of the transported villi is governed solely by the covering epithelium. In moles, the close relations between which and chorionic epithelioma have been brought out by the study of the latter, it does not concern myxoma of the chorion, as formerly believed, but rather an increase of the formative activity of the chorionic epithelium on account of the increased nutrition which occurs after the death of the fœtus; the imperfect excretion of fluid and substances in solution lead to vacuolation and separation of the syncytial cells, which continue to multiply and may enter the maternal organism by a process of active migration in response to chemotaxis. On this account the necessity of early and radical treatment becomes self-evident.

On the basis of two new, carefully described cases of chorionic epithelioma, Marchand would distinguish between two forms, the typical and the atypical. In the typical the chorionic epithelium appears as it is seen in the first period of pregnancy, namely, as irregular, branching, protoplasmic masses and bands associated with polyhedral clear cells like those in Langhans's layer. In the atypical form the cells are irregular and compact, their nuclei large, often gigantic, and deeply stained; multinuclear clumps are present, but not any continuous syncytial masses. Transitions between the two forms occur. The atypical variety, when infiltrating tissue diffusely, may resemble sarcoma, but the cell arrangement may also resemble that of carcinoma. In the latter case there may occur an extensive intravascular, often subendothelial, growth, and the latter may penetrate into the lumen of the vessel far from the starting-point; the tumor growth may spread along the lymphatics in the same manner, and break into the veins; the secondary nodules in the vagina and elsewhere may originate in this manner.

The combination of branching syncytial masses, with clear polyhedral cells containing glycogen, the absence of vessels and of connective tissue in the intravascular growths, and the irregular blood spaces in the cell masses associated with fibrinous precipitates, are peculiarities observed only in proliferations of chorionic epithelium. The best name which Marchand can find for these tumors is *chorio-epithelioma malignum s. destructans*.

Among the new cases of chorio-epithelioma may be mentioned those of Scherer¹ and Trautenroth,² who each report two. Stankiewicz³ describes a case in which the growth began its development during pregnancy.

Kelly and Teacher⁴ describe a typical case of chorionic epithelioma with metastases in the lymph-glands at the sides of the cervix, from

¹ Arch. f. Gynäk., 1898, vol. lvi.

² Monatsschr. f. Geb., 1898.

³ Centralbl. f. Gyn., 1898, No. 38.

⁴ A Case of Deciduoma Malignum. Journal of Path. and Bact., 1898, vol. v. p. 358.

which the adjacent veins were invaded. There were secondary tumors in the lungs. The microscopical description clearly shows that both layers of the epithelium of the chorionic villi are represented in the tumor.

Beffel¹ reports a case following abortion. There were metastases in the gall-bladder, the liver, and the lungs. This is only the second carefully studied case published from the United States, the first having been that of Williams,² who pointed out that some of the apparently single cells observed in these tumors may be produced by cross-sections of syncytial bands.

Authors still differ widely as to the origin of the epithelial covering of the chorionic villi, and this has become a burning question in connection with the genesis of the chorio-epithelioma. Pfannenstiel³ brings forward certain theoretical reasons for believing that the syncytium is derived from the endothelium of the maternal vessels, and Freund⁴ claims priority in urging this view in Germany. Marchand⁵ calls attention to the absence of any definite proof of Pfannenstiel's theory, and emphasizes that chorionic epithelioma may originate in the entire epithelial covering of the villi, because its cells correspond partly to the syncytium, partly to the elements in Langhans's layer; concerning the fetal and ectodermal nature of the latter there is hardly any question now. The directive rôle of the syncytium in the growth of chorionic villi speaks in favor of its fetal origin. The two layers in the epithelial covering are almost inseparable, and the nuclei of each are not radically different; further appearances occur which indicate that cells may separate from the syncytium. In chorio-epitheliomas it may be impossible to differentiate between altered syncytium and Langhans's cells; there are also transitional forms which point to a common origin of the two layers.

An excellent summary of the present state of the many and complicated problems connected with tumors of the chorionic epithelium and their relation to the normal histology of the placenta is given by Gaylord,⁶ whose general conclusions closely coincide with those of Marchand in his recent articles. H. L. Williams⁷ reviews the whole literature quite completely.

Neuroglioma and Ganglionic Neuroma. Carl Weigert's recent monograph,⁸ embodying the results of his long-promised special neuroglia stain, and the independent technical publications of similar bearing by

¹ Malignant Placentoma. *American Gynecological and Obstetrical Journal*, October, 1898.

² *American Journal of Obstetrics*, etc., 1896.

³ *Centralbl. f. Gynäk.*, 1898, 23.

⁴ *Loc. cit.*, 26.

⁵ *Loc. cit.*, 30.

⁶ *American Journal of Obstetrics*, etc., 1898, vol. xxvii. p. 145.

⁷ *Proceedings Philadelphia Path. Soc.*, New Series, 1898, vol. i. No. 4.

⁸ *Beiträge zur Kenntniss der normalen menschlichen Neuroglia*, 1895.

Frank B. Mallory,¹ of Boston, have thrown much new light upon the neuroglia, and it seems now to be generally accepted that the neuroglia cells and fibres in the adult human central nervous system are separate and distinct. The use of these methods in the study of tumors of the brain has been to good advantage.

H. M. Thomas and Alice Hamilton² describe a tumor involving the subcortical white matter of the ascending frontal, ascending parietal, and the third frontal convolutions, in a man aged thirty-eight years. The tumor possessed two quite distinct classes of cells: one characterized by faint outlines and a faintly staining protoplasm, delicate processes if any were present, and often slightly stained nuclei; the other class showed granular protoplasm, distinct outline, thicker processes, and usually a deeply stained nucleus. In addition, there were normal neuroglia cells and spindle cells, some of which had single, or bunches of, long processes. There were also cells with many nuclei. The bloodvessels, not very numerous in the tumor, usually showed the walls thickened by the presence of spindle cells. Medullated nerve fibres were found in all parts of the tumor, as were naked axis cylinders. The tumor is regarded as a neuroglioma.

It is interesting to note that the nerve fibres in this case passed through the tumor apparently unchanged; some, perhaps, lost their medullary sheaths. This fact explains the frequent absence of degeneration of neuron tracts occupied by such growths.

A. F. Lemke³ describes an instance of neuroglioma ganglionare of the brain. This diagnosis seemed justifiable in view of the occurrence in the tumor tissue of large nucleated ganglion cells and smaller cells, some of which contained a small zone of perinuclear protoplasm, while in others nothing but a nucleus could be seen.

Professor Klebs made a careful examination of Lemke's preparations, and stated very positively that the tumor is to be classed with the tumors Klebs has described as neuroglioma ganglionare.

It will be remembered that Raymond, as well as others, considers that some glia cells are capable, under the proper stimulus, of being transformed into genuine nerve cells. Raymond speaks of this glia cell as the "Ersatzzelle." Some observers, on the other hand, insist that these ganglion cells and nerve fibres can only be derived from pre-existing nerve cells. If we regard the cells of gliomas as representing earlier or later stages of development of the indifferent cells in which these tumors may be assumed to originate, atypical glia cells, as well as atypical ganglion cells, may be expected to occur.

¹ Centrabl. f. allg. Path. u. path. Anat., 1895, vol. vi. p. 753.

² Journal of Experimental Medicine, 1897, vol. ii.

³ The Psychiatrist, 1898, vol. i. p. 13.

In a glioma examined by E. W. Taylor,¹ by the special neuroglia stains he was able to demonstrate a chemical difference between the neuroglia fibres and the protoplasm of the cells. Weigert's view, that the fibres are distinct from the cells, would seem to be confirmed, at least as regards mature glia tissue. Taylor found also some elongated neuroglia cells, from one pole of which emerged tapering processes which stained similar to the protoplasm of the cell, and he concludes that such fibres were direct outgrowths of the cells. In a second tumor the cells were more of a transitional type; differentiated fibres in Weigert's sense—*i. e.*, separate from the cells—were not demonstrated by means of the special stains. The tumor is looked upon, therefore, as a young growth, consisting of cells with undifferentiated fibres. Later on differentiated or free fibres might have come to be the striking structural element.

Taylor's general conclusion in this case is that the development of neuroglia, in all probability, goes from cells with protoplasmic processes to cells lying among differentiated and independent fibres; herein lies the possible reconciliation of the conflicting views of Stroebe and Weigert concerning the ultimate structure of human neuroglia.

The recognition, through the studies of W. His, Cajal, and others, of the epiblastic origin of neuroglia, has led to a radical change in the views held of this tissue, both in its normal and in its pathological conditions. Neuroglia from a histogenetic stand-point is different from ordinary connective tissue; but one should not lose sight of the fact upon which Weigert places so much stress, namely, that its function in the nervous system is similar to that of connective tissue in other organs.

The placing of glioma among the mesoblastic tumors, as is done in our text-books, whose onchological classification is generally based on embryological grounds, is plainly incorrect. Embryologically a glioma is an epiblastic tumor; histologically it resembles the mesoblastic tumors, especially in the relation which its cells bear to the stroma of the growth, and consequently, Hansemann, for instance, whose division of the tumors is based solely upon the relation of the "parenchyma" to the stroma, naturally places glioma among the tumors currently called mesoblastic. The term gliosarcoma, which was formerly used to designate pure gliomas, should be dropped entirely, or at the very utmost applied only to mixed gliomatous and sarcomatous (mesoblastic) tumors, of which there is probably not yet a genuine example described (Thomas and Hamilton).

That ganglion cells may take part in tumor-growths is also shown in the true ganglionic neuromas. Busse² describes a true ganglionic neu-

¹ Journal of Experimental Medicine, 1897, vol. ii.

² Ein grosses Neuroma Gangliocellulare des Nervus Sympathicus. Virchow's Archiv, 151, Supplementheft, 1898, p. 66.

roma of the subcutaneous tissue of the back in a four-year-old child; it contained medullated and non-medullated nerve fibres, and is, therefore, ascribed to proliferation of sympathetic nerves.

Knauss¹ reports an instance of multiple amyelinic, ganglionic neuroma in the subcutaneous tissue of the trunk of a seven-year-old child.

These observations establish the occurrence of genuine neuroma in Virchow's sense, and show that proliferation of ganglion cells does take place. So far the sympathetic nervous system seems to play the part of matrix in the growth of ganglionic neuromatous growths.

Bencke² refers the origin of ganglionic neuroma, of which he observed two striking examples, to proliferation of the ganglion cells, which alone can produce the axis cylinders.

Adrenal Tumors of the Kidney. The development of peculiar tumors from misplaced adrenal remnants, more particularly into the cortex of the kidney, which was first established by Grawitz in 1883, has now become generally recognized. An idea of the relative frequency of adrenal tumors of the kidney is given in Kelly's³ article based on Vienna material. In 3098 post-mortems made in the course of three and a half years, there were seven tumors of the kidney, and of these four were of adrenal origin, and there were but two instances of tumors of the adrenal proper, one a so-called struma or adenoma (benign) and one malignant.

The histological and embryological peculiarities of the adrenal preclude the satisfactory arrangement of the tumors of adrenal structure, heterotopic or not, in the generally accepted scheme of onchological classification; hence such names as adrenal tumors of the kidney and hypernephroma.

Angiosarcoma. The angiosarcomatous tumors, in the formation of which the tissue of the vessel-wall and its surroundings take special part, are receiving much notice. Ziegler, in the ninth and last edition of his text-book (1898), suggests that the term endothelioma should be restricted to tumor proliferations of the endothelium of the lymphatic spaces and vessels—*i. e.*, to the lymphangiosarcomas. The proposal of Hansemann to return to a purely morphological classification, and to include the endotheliomas among the carcinomas, on account of the similarity in structure, has not met with favor. The establishment of an endothelial carcinoma would tend to still more confusion in the nomenclature of tumors.

Among the recently described and more interesting endotheliomas, may be mentioned the one of the cervix uteri described by Elizabeth

¹ Zur Kenntniss der Aechten Neurome. Neuroma verum multiplex amyelinicum gangliosum. Virchow's Archiv, 1898, vol. cliii. p. 29.

² Centrabl. f. allg. Path. u. path. Anat., 1898, vol. ix. p. 846.

³ Ziegler's Beiträge, 1898, vol. xxiii. p. 280, and Philadelphia Medical Journal, 1898.

Hurdon¹—an extremely rare tumor. Eberth and Spinde² observed multiple typical subcutaneous endotheliomas in three white mice of the same family. Inoculation experiments gave negative results. Best³ records an endothelioma of the choroid, which developed from the lining of the perivascular lymph-spaces and whose cells contained glycogen. Glycogen is quite characteristic of endotheliomas, and is often of different solubility than that of the liver; absolute alcohol, formol, and formol-alcohol preserve it quite well.

Krompecher⁴ finds that the epithelial tumors of the testicle are much less frequent than the non-epithelial, which for the most part are of endotheliomatous or sarcomatous nature. The endotheliomas originate from the endothelium of the lymph-spaces, in the larger of which it is possible to demonstrate this origin directly; part of these tumors present a diffuse cellular infiltration, others an alveolar structure (alveolar sarcoma), and these are the more frequent. The sarcomas and endotheliomas of the testicle are frequent in childhood and before forty; the endotheliomas of the large lymph-spaces grow slowly. These statements are corroborated by Most,⁵ in his report of several malignant testicular tumors.

The distinction between endothelioma (lymphangiosarcoma) and hæmangiosarcoma cannot always be carried out fully. There may be tumors which answer to both designations. In certain hæmangiosarcomas the proliferation of the endothelium of the bloodvessels may be so pronounced that the tumor could also be quite properly called endothelioma.

Borrmann⁶ describes a walnut-sized tumor of the scrotum which he found to be a genuine hæmangioendothelioma, or tubular, capillary endothelioma. The capillary endothelium sent out buds, as in the formation of new capillary loops in regeneration, and new capillary tubes were produced, the lumen of which soon became crowded by the endothelial cells, so that the blood could no longer enter. He could find only four somewhat similar tumors described in literature.

Limacher⁷ describes two tumors of the thyroid which he traces to the endothelium of the bloodvessels, in one case to the interfollicular capillaries, in the other to the vessels in the interlobar septa. In the first

¹ Johns Hopkins Hospital Bulletin, 1898, vol. ix. p. 186.

² Virchow's Archiv, 1898, vol. cliii. p. 60.

³ Ueber die Bildung von Glykogen und Pigment in Sarkom der Aderhaut. Ziegler's Beiträge, 1898, vol. xxii. p. 253.

⁴ Ueber die Geschwülste insbesondere die Endotheliome des Hodens. Virchow's Archiv, vol. cli., Supplementheft, 1898, p. 1.

⁵ Virchow's Archiv, 1898, vol. cli. p. 159.

⁶ Ein Blutgefässendotheliom, mit besonderer Berücksichtigung seines Wachstums. Virchow's Archiv, vol. cli., Supplementheft, 1898, p. 151.

⁷ Ueber Blutgefässendotheliome der Struma. Virchow's Archiv, vol. cli., Supplementheft, 1898, p. 113.

case the proliferation took the form of tubules and columns of cells, resembling somewhat an alveolar sarcoma. In the second case the structure was more cavernous, composed of long, irregular spaces, lined with a continuous cell layer, partly filled with blood and communicating with the veins.

Most¹ describes an alveolar tumor of the testicle; the spaces were lined with endothelioid cells, which in the larger ones formed dendritic columns; throughout all the alveoli and spaces was blood; the proliferation could be traced to small blood-containing spaces and to the capillaries, and there is, therefore, no doubt but that it concerns a hæmangioidic endothelioma.

Teratoma. Eberth² records a subdural, split-pea-sized nodule composed of lymphoid tissue, fat, muscles, and nerves. Such mesodermal formations are very rare in comparison with the intracranial epidermoids.

Felix Ran³ adds the third reported instance of entodermal cyst lined with ciliated epithelium at the lower end of the œsophagus. The developmental twist that occurs near the junction of the stomach and the œsophagus may give rise to evaginations which subsequently become closed. As the œsophagus is the only one of the structures in question which ever possesses ciliated epithelium, the cysts must originate from this tube and not from the stomach.

Hebing⁴ describes a teratoid tumor which entirely replaced the left lung. The following mesodermal structures were present: Round and epithelioid cells, fibrillar connective tissue, cartilage, and striped muscle tissue; there were also epithelial formations in the shape of cysts and gland-like proliferations; there were no large vessels or bronchi. It is assumed that in all probability the aberrant matrix of the teratoma was the cause of the aplasia of the left lung. In other cases of absence of a lung there have been found hydrothorax (*ex vacuo*) and a marked compensatory hypertrophy of the present lung.

Misick⁵ describes a unique teratoma of the liver which occurred in a six-weeks-old boy, and occupied the lower half of the right lobe of the liver. It was a vascular, yellowish-gray, lobulated, cystic growth, which had infiltrated the wall of the portal vein. Histologically it showed itself a true teratoma; there were spots of liver tissue, large gland-ducts, cholesteatomatous balls, many new bloodvessels with young red globules, sarcomatous connective tissue, and areas of bone.

¹ Loc. cit.

² Intracranielles Teratom mesodermaler Ursprungs. Virchow's Archiv, 1897, vol. cliii, p. 76.

³ Flimmerepitheleyste des Oesophagus. Virchow's Archiv, 1898, vol. cliii, p. 26.

⁴ Centralbl. f. allg. Path. u. path. Anat., 1898, vol. ix, p. 133.

⁵ A Case of Teratoma Hepatis. Journal of Pathology and Bacteriology, 1898, vol. v, p. 128.

A re-examination, by Kauthack and Pegg,¹ of Sir James Paget's celebrated case of malignant chondroma of the testicle,² which is generally cited as an example of chondroma giving rise to metastasis, shows that it is a typical columnar-celled carcinoma, with cysts and cartilaginous masses. While the authors regard this tumor, not as a mixed growth, but as a carcinoma with mucoid degeneration of the stroma and metaplasia into cartilage, yet the frequent occurrence of teratoma (embryoid tumor of Wilms) in the testicle would seem to render the interpretation that this is another example of malignant teratoma of the testicle as the one more likely correct.

Douglas W. Montgomery³ describes a solid, recurrent teratoma in the abdominal cavity of a twelve-year-old girl. This tumor was remarkable on account of the great variety of tissue which it contained from all three of the germinal layers, including masses of the central nervous system, peripheral nerves, and distinct evidences of rudimentary eye structures. In the absence of any ganglion cells in the tumor, so far as examined, Barker suggests that the nerve fibres present were ingrowths from the body of the patient and prolongations of some of the nerve cells of the host. The latter view, he remarks, would not be surprising, considering the recent findings, by Young,⁴ of nerves in sarcomas and other tumors.

Barker⁵ ably reviews the various theories of the origin of teratoid tumors. Naturally he finds that the theories of congenital origin have most in their favor, and that Meckel's theory of fetus *in fetu* accords well with the majority of these complicated formations. Klebs divided teratomas into two classes: 1. The endogenous, from tissues pinched off in embryonal development (autochthonous teratoma, monogerminal implantation), and, 2. The ectogenous, due to foetal (bigerminal) implantation. The ectogenous is represented by two varieties: the allantoid, in which one fetus is situated in a cavity of the other, and the preallantoid, in which there is direct fusion of the germinal areas of the two fetuses at an early stage, one including the other.

It is generally assumed that in foetal inclusions two separately fertilized eggs are concerned. Sobotta, Marchand, and others suggest, however, that "directive corpuscles" may become fertilized and develop. The long period of dormancy in the development of teratoma is hard to explain, but it has been shown experimentally and otherwise, speak-

¹ Journal of Pathology and Bacteriology, 1898, vol. v. p. 89.

² Described in the Transactions of the Medico-Chirurgical Society, 1855, vol. xxxvii. p. 27.

³ A Teratoma of the Abdominal Cavity. Journal of Experimental Medicine, 1898, vol. iii. p. 259.

⁴ Journal of Experimental Medicine, 1897, vol. ii. p. 1.

⁵ Ibid., 1898, vol. iii.

ing in general, that there are conditions which suspend cell division which, under other more favorable surroundings, may be resumed. Barker then calls attention to the fact that the possible origin of teratoma, from the splitting in the long axis of the single embryo, cannot be neglected in view of the results of modern experimental teratology. The objection, that gross defects might result, does not hold good, because of the remarkable regenerative power of the embryo after injury. In many animals a whole embryo may develop from each of the two segmentation cells isolated by shaking, and larvæ may grow from a single cell separated from the eight or sixteen-cell embryo. Roux observed single segmentation cells in the bodies of young frog larvæ. It becomes apparent, then, that experimental teratology furnishes a mass of data which points the way to a satisfactory hypothesis in regard to human malformations and teratoid growths. The complicated relations in many teratoid growths result from activities in the included cells under extraordinary influences and correlations. The support which the facts observed in connection with teratomas lend to Colnheim's theory, of the origin of tumors in general, has already been emphasized.

PATHOLOGICAL ANATOMY.

Endocarditis. Harbitz,¹ who writes an important article on the pathological anatomy and etiology of endocarditis, lays stress upon the necessity of studying the histology of the valvular vegetations, and upon the study of cover-glass preparations, in order to control the result of the cultures, and, finally, upon the necessity of comparing the pathologico-anatomic results with the clinical history. Following Hanot, he divides endocarditis into infectious and non-infectious. The first class includes the endocardial inflammations due to streptococci, pneumococci, staphylococci, and gonococci. Endocarditis due to the bacillus of typhoid fever is regarded as proved, although it is rare; but, on the other hand, he finds there is hardly enough evidence to prove the existence of a tuberculous endocarditis.

The second class includes the endocarditis of rheumatism, and the endocardial vegetations of tuberculosis, carcinoma, Bright's disease, etc. Harbitz studied 54 cases; 39 belonged to the first class, and of these 17 were due to streptococci, 5 to pneumococci, 7 to staphylococci, and 2 to gonococci. Of two others one is attributed to an unknown micrococcus, the other to an unknown bacillus. And, finally, there are 6 cases of healed infectious endocarditis. Fifteen cases belonged to the second class; 5 occurred in connection with acute articular rheumatism, 7 with tuberculosis, and three with other chronic diseases.

¹ Om Endokardit, 1897.

Harbitz finds it convenient, as well from the pathologico-anatomic point of view as from the clinical and etiological, to distinguish between two great groups of infectious endocarditis. One includes the endocarditides which are accompanied by considerable outgrowths, composed partly of a hyaline thromboid mass and partly of embryonal connective tissue. It is rare to find in these excrescences round-cell infiltration, and there are no necrotic zones surrounding the masses of bacteria. The bacteria are often found toward the border of the thrombic mass, which they may surround. In order to demonstrate this relation of the bacteria to the vegetations, it is necessary to make careful sections. The picture indicates the existence of a limitative process and not that of a destructive and ulcerative one. In these cases there were often found numerous anæmic infarcts, free from suppuration. There were no foci of suppuration in any of the other organs in the cases studied. These forms are oftenest caused by the streptococcus and pneumococcus, and these are present, as stated, most often in huge masses. In general it is not possible to find the source of the bacterial invasion.

These forms of infectious endocarditis present also certain peculiarities from a clinical stand-point. Their beginning is insidious, their progress slow. It may be six months or more from the beginning of the disease until it comes under observation. Many of the cases appear to begin with cerebral embolism. In a certain number of the cases there is slight fever of an indefinite type, and sometimes the joints are swollen and painful. Some of these cases also manifest renal symptoms, the clinical picture being that of a hemorrhagic nephritis, due in part, perhaps, to mechanical disturbances in the circulation of the kidney, in part to infectious or toxic substances.

Harbitz also describes cases of infectious endocarditis which healed spontaneously, and in which there were large outgrowths upon the valves as well as upon the parietal endocardium, although the cultures remained sterile, while the sections showed indistinct, degenerated bacterial masses at the borders. Harbitz considers it probable that these were cases of streptococcus infection.

The second group is formed by the endocarditis, which is part and parcel of a general pyæmic process. The lesion is mostly ulcerative; there is a necrotic zone around the bacterial masses, a marked round-cell infiltration, and there are multiple suppurative foci here and there in the body, and also infarcts which are generally suppurating. These cases are most often caused by staphylococci. External lesions serve as the atrium, and the evolution of the disease is rapid.

In two cases the author found micro-organisms which morphologically and from staining characteristics corresponded to the gonococcus. He was unable to cultivate them. After referring to gonorrhœal endocar-

ditis as described in literature, including the case of Thayer and Blumer, Harbitz concludes that it most likely concerned the gonococcus.

The endocarditis of rheumatism is characterized by small, warty vegetations, which by preference affect the free border of the valves, and which remain circumscribed. Examined while fresh they consist of a hyaline thromboid substance, at the base of which there is a little embryonic connective tissue. Bacteria are not found in cover-glass, culture or sections. Harbitz submits that this endocarditis may be due to attenuated microbes, which act either by implantation or indirectly by toxic products. A superficial necrosis of the endothelium at the line of closure, the part most exposed to traumatism, leads to precipitation of fibrin, which is followed by proliferation of the substance of the valve.

A similar explanation is given of the excrescences which often accompany tuberculosis, cancer, Bright's disease, etc., where the bacteriological examination is negative. In Bright's disease it seems reasonable to assume that the abnormal substances in the blood may injure the endothelium. Harbitz did not find tubercles or tubercle bacilli in the endocardial excrescences in cases of tuberculosis. By inoculating vegetations into guinea-pigs he obtained, in one case, positive results; but it may be that this was due to the entanglement, of bacilli circulating in the blood, in the deposits on the valve.

A number of successful experiments were made, infectious endocarditis following the intravascular injection of various bacteria. On the other hand, injection of sterilized cultures did not produce any valvular lesions.

The occurrence of a real tuberculous endocarditis, which is doubted by Harbitz, seems placed beyond question by such a case as Benda's,¹ which occurred in a boy with general miliary tuberculosis; among the warty outgrowths on the mitral valve was a rough yellow nodule of granulation tissue without giant cells, the surface of which was necrotic in places and covered with enormous numbers of tubercle bacilli, from which general infection must have occurred.

Michaelis and Blum,² who first lacerated the aortic valve in rabbits through the carotid artery and then made intravenous injections of suspensions of tubercle bacilli, produced a diffuse tuberculosis and delicate vegetations on the aortic valve, containing tubercle bacilli, and in one case a typical tubercle developed. They conclude that the tubercle bacillus may cause a verrucose endocarditis.

Myocardial Segmentation and Fragmentation. MacCallum³ contributes a valuable paper on the pathology of myocardial fragmentation and of fibrous myocarditis, which certainly throws some new light

¹ Deutsche med. Wochenschrift, 1898, No. 7.

² Loc. cit., No. 35.

³ On the Pathology of Fragmentatio Myocardii and Myocarditis Fibrosa. Johns Hopkins Hospital Bulletin, 1898, 89 (Synopsis).

on the dark points which remain in the genesis of these important lesions, in spite of other recent investigations.

The protoplasm of the heart-muscle cell consists of a definite network of the fibril bundles and the membranes bounding the sarcoplasmic disks. The differentiation of the embryonal cell results in the formation of fibril bundles at the periphery of the cell earlier than in the centre.

An extended fibre is recognized by the narrow cells, the greater than usual distance between the transverse striations of the fibril bundles known as Krause's membranes, and the approximation of the bundles. In all severe examples of dissociation of muscle fibres there is an uneven extension and contraction of its component cells: even the same cell may be in part extended, in part contracted; the breaks may occur either in the body of a cell or at the cement line.

There is also a degenerative process in the muscle fibres associated first with extension and later with irregularities in the striations and changes in the relation of the sarcoplasm to the fibril bundles, leading finally to disintegration and breaking of the fibre—a sarcolytic degeneration, as proposed by MacCallum.

In the cases examined this degeneration was in each instance the most conspicuous lesion, throwing, it would seem, much of the muscle out of function, so that the simple separations in the remaining healthy fibres are produced mechanically by the unequal strain on undegenerated muscle.

In fibrous myocarditis the process is as follows: The undifferentiated sarcoplasm in the centre of the cell increases at the same time as the fibril bundles disappear, until but a single row is left at the periphery of the cell, which is also lost. The cell becomes somewhat spindle-shaped, finally disintegrating entirely. It will be seen that, while the differentiation occurred toward the centre, this degeneration pursues the opposite course, namely, centrifugally, so that the last stage in the degenerative process resembles the earliest in the developmental.

Syphilitic Myocardial Foci. E. R. Le Count¹ adds another instance of multiple foci of interstitial myocarditis with areas of degeneration, leucocytic infiltration, and giant cells, occurring in a case of congenital syphilis. To the naked eye the lesions appeared in the form of limited areas of whitish color and of rather soft consistency. This makes only the eleventh case of this kind which has been described in literature.

Dissecting Aneurisms of the Heart. Arthur Vestberg² defines dissecting aneurism of the heart as a pathological cavity communicating

¹ Gummas of the Heart in a Case of Congenital Syphilis. *Journal of the American Medical Association*, January 22, 1898.

² *Nord. med. Arkiv.*, 1897, Nos. 26 and 30.

with the heart or with the origin of the aorta, due to a separation by the blood of the layers of the walls of the heart.

The affection occurs in four varieties :

1. The parietal form, the cavity being situated between the layers of the external walls of the heart.

2. The septal variety, where the aneurism is situated in the septal walls.

3. The valvular variety, in which the cavity lies between the layers of a cardiac valve.

4. The interparietal variety, occurring between the exterior surfaces of the heart cavities, which are normally united by loose cellular tissue.

The last variety is the most common, and occurs in the periaortic space (Vestberg) of the heart. This is a subpericardial cellular space, the external wall of which is formed in part by the anterior wall of the auricles, in part by the *conus arteriosus dexter*. Its internal wall is formed by the lowermost part of the aorta, by the root of the aorta, and by the inconstant and incomplete *conus arteriosus sinister*. A rupture of the central or internal wall of this space allows the blood to penetrate into it, separating the walls and lifting up the roof of the space which is formed by the epicardium. Thus is established a dissecting aneurism in all or part of the periaortic space. From the periaortic space the blood can pass into the ventricular or auricular septum, circumstances which render it impossible to separate interparietal from aneurisms of the septa. There are also transitions of the interparietal aneurisms to the parietal.

The interparietal aneurism described by Vestberg occurred in a woman, thirty-two years old, and was associated with chronic and acute endocarditis. A rupture of the central or internal wall of the periaortic space, between the aortic valves at the base of the anterior mitral valve, had taken place, with the formation of a dissecting aneurism in the auricular part of the space. Including Vestberg's case, the total number of dissecting aneurisms of the heart is sixty. Forty-seven were interparietal or septal. Excluding the valvular cases the point of departure in thirty cases was the left ventricle ; one parietal aneurism appeared over the right auricle. In sixteen cases the aneurism took its origin from the *sinus of Valsalva*. The cause in most cases was endocarditis, generally of an acute, ulcerative nature. Sometimes an abscess appeared to have existed where the aneurism formed ; in other cases the break was due to atheromatous changes in the aorta, or was secondary to rupture of an ordinary aortic aneurism. In two cases the primary rupture was probably traumatic.

The interparietal aneurisms are often like a pouch, but they may occupy the larger part of the space, in which case they take its form. The opening of the aneurism may be linear, especially when due to

rupture, or it may be rounded when due to ulceration. Aneurisms in the early stages have no wall proper, but in the chronic cases there is formed a secondary membranous wall. Frequently the cavity is filled with a thrombus. Secondary ruptures into the cavities of the heart may occur, causing abnormal communications between them, or, more rarely, the rupture may be into the pericardium.

Among the valvular aneurisms two were of the valves of the aorta, starting from its lumen. Two were formed in the septal curtain of the tricuspid valve, and four in the anterior mitral curtain.

Stenosis and Obliteration of the Aorta at the Opening of the Ductus Arteriosus. Emil Wadstein has collected 113 cases of narrowing and closure of the aorta at or near the ductus Botalli; five are new cases. Atresia was present in twenty of the cases. In 16.4 per cent. the maximum narrowing was above the duct; in 38.8 per cent. on a level with the duct; in 44.8 per cent. below it. Occasionally the narrowing may be double. In one-third of the cases the aorta was sclerotic, and, in the majority of these cases, more so on the proximal side of the narrowing. In view of this location of the process and of the early age of the patients, the author favors increased pressure as being the explanation of the sclerosis. Both the ascending aorta and the arch were often dilated, sometimes in an aneurismal form. Hypertrophy of the heart, especially the left side, and the formation of collateral circulation are also important secondary changes. The blood may reach the lower part of the body by three main routes: 1. By the abdominal aorta, by way of the intercostal arteries. 2. By the superficial epigastric and long thoracic arteries on one side, and on the other the deep epigastric. 3. By anastomoses of the intercostal and the ilio-lumbar and circumflex iliac arteries.

The most reasonable explanation of the majority of the cases of narrowing seems to be, according to Wadstein's summary of the numerous theories on this point, that the connective-tissue proliferation which closes the ductus arteriosus extends into the walls of the aorta and then contracts. In other cases, congenital abnormality in the arrangement of the structures of the artery may lead to stenosis, and such was the case in an example examined by Wadstein, in which the media formed a ring-like thickening under the greatly increased intima.

Fibrinous and Mucous Bronchitis. The exudate formed in the bronchi and coughed up in the shape of a more or less complete cast of the bronchial tree, in the disease known as fibrinous bronchitis, has been the subject of investigation by Herzog.¹ In two characteristic chronic cases he found the casts to be composed of true fibrin, as shown by fine-

¹ *Centralbl. f. allg. Path. u. path. Anat.*, 1897, vol. xiii. p. 1003.

torial and chemical tests. In contradistinction to this true fibrinous bronchitis, there undoubtedly occurs a mucinous bronchitis, with quite similar clinical features, the casts, however, being made up of mucin. Habel¹ found that in two cases of fibrinous bronchitis the casts consisted of mucin. He believes that the casts were formed by the coagulation of mucus due to acids produced by bacteria. It would seem that these two kinds of bronchitis ought to be distinguished between and be given distinct names.

Gastric Syphilis. There are fourteen authentic cases of syphilis of the stomach on record, five in inherited, nine in acquired, syphilis. According to Flexner,² all but one, which is a case by Cornil and Ranvier, are from Germany. Flexner adds the first English case, which occurred in a man of fifty-two years, who died from perforative peritonitis. In the fundus of the stomach was an ulcer 5 by 5 cm., with thick and firm edges and a small rupture; in the liver were confluent gummatous masses. The floor and edges of the ulcer, which extended to the muscular coat, consisted of a granulation tissue containing foci of coagulation necrosis; dense fibrous tissue extended out into the submucosa, the vessels of which showed obliterative changes and organizing hyaline thrombi. The ulcer is regarded, therefore, as being due to softening of submucous gummatous infiltration on account of nutritive interference.

Cysts of the Urethra and the Ureters. W. Falta³ describes a urethra in which the mucous membrane of the cavernous part was covered with numerous, whitish-gray to black-brown, punctiform, glistening nodules. The microscopic examination in serial sections showed the presence of fully developed glands and developing glands in all stages of formation. The presence of solid epithelial columns, and of all stages of development of these columns into glands, proves that the great number of glandular formations in this case depended upon epithelial proliferation. As occurs more commonly in the case of new formation of glands in the pelvis of the kidney and in the ureters, these urethral glands had changed into cysts with mucoid contents; but there had also occurred a more extensive transformation into follicles of a prostatic character, with metamorphosis of the cells into homogeneous colloid masses, and the production of typical prostatic concretions. Most likely the epithelial proliferation received its original stimulus in consequence of an inflammatory process which had long before passed away.

Markwald⁴ examined the ureters in 700 cases, and found a well-

¹ *Centralbl. f. innere Medicin*, 1898, No. 1.

² Gastric Syphilis, with the Report of a Case of Perforating Syphilitic Ulcer of the Stomach. *American Journal of the Medical Sciences*, 1898, vol. cxvi, p. 424.

³ Ueber den Befund reichlicher colloidhaltiger Cysten in der Urethra eines 77 j., Mannes. *Prager med. Wochenschrift*, 1898, vol. xxiii, Nos. 17-22.

⁴ *Münch. med. Wochenschrift*, August 16, 1898.

marked ureteritis cystica in 4 cases; in 1 case many of Brunn's cell-nests and few cysts; in 57 cases slight cystic change. The branched or solid groups of flat epithelial cells, known as Brunn's cell-nests, occur in all ureters; degeneration of the cells composing them gives rise to cysts.

Phlebo-thrombotic Ulcers of the Vagina. There are certain rather shallow, sharply defined, oval ulcers of the mucous membrane of the vagina (ulcus rotundum of Zahn) which have been ascribed by some to arterial obliteration. Grosvenor,¹ in several cases in Chiari's institute, observed similar ulcers of the vagina due to nutritive disturbances on account of venous stasis associated with thrombosis in the veins of the vaginal walls.

Apoplexy of the Uterus. Cruveilhier, Rokitsansky, and others first described so-called apoplexy of the uterus. Von Kahlden² details the results of an anatomical study of several instances. The size of the uterus and of its cavities vary, but there is found everywhere a more or less pronounced hemorrhagic infiltration which, in severe cases, extends into the muscular coat. The mucous membrane of the cervix is normal. The striking changes in these organs are situated in the vessels: the arteries present irregular calcification of the media with narrowing of the lumen; the intima is often ten times thicker than normal, and the muscle is the seat of a granular or hyaline degeneration. The veins are dilated and filled with blood, the uterine muscle necrotic and substituted by connective tissue. Von Kahlden looks upon the hemorrhagic infiltration as due to degenerative changes in the vessels of the mucosa. The etiology of the process is obscure; the conditions upon which it may depend are pregnancy, menstrual congestions, and prior inflammations. The possibility of hemorrhage in the uterine mucosa should be borne in mind in the efforts to diagnosticate carcinoma from uterine scrapings.

Congenital Anomalies of the Duct of Müller. Henrotin and Herzog report two cases of extra-uterine pregnancy apparently due to developmental anomalies in the duct of Müller, consisting in one case of an accessory tube which communicated directly with the lumen of the oviduct proper, and in the second case of a congenital diverticulum which ended in a blind sac.

Carcinoma and Papilloma of the Fallopian Tubes. The development of carcinoma upon the basis of chronic inflammatory processes is well illustrated by Hoffbauer's³ case of a double, cylindrical-celled, villous carcinoma of the Fallopian tubes, the seat of chronic salpingitis. The case is interesting, also, because there was a flat-celled carcinoma of the

¹ Phlebo-thrombotic Ulcers of the Vagina. *Journal of Pathology and Bacteriology*, 1898, vol. v. p. 111.

² Ueber die sogenannte Apoplexia Uteri. *Ziegler's Beiträge*, 1898, vol. xxxiii. p. 1.

³ Ueber primäres Tubercarcinom. *Archiv f. Gynäkologie*, 1898, vol. lv. p. 316.

cervix ; in other words, it is an instance of two simultaneous primary carcinomas of different structure in the same individual.

Ries¹ describes an interesting combination of neoplasms in the Fallopian tubes, namely, bilateral adenomas of the usual appearance, first described by von Recklinghausen,² and double papillo-carcinomatous masses. This coexistence is regarded as accidental.

Papilloma of the Fallopian tube is a very rare tumor. There are now but eight cases described in literature. The seventh is described by Ries,³ and the eighth by Clarke,⁴ whose case occurred in a woman, sixty years old. The cystic papillomatous tumor, which grew to half the size of a man's head, had developed upon the basis of a chronic salpingitis. The cysts observed in these tumors are formed by the coalescence of the papillomatous offshoots.

Adenomyoma of the Round Ligament. Blumer⁵ describes a further example of adenomyoma of the round ligament, a recently discovered tumor. Cullen⁶ had occasion to extirpate a second adenomyoma in the opposite groin of his original case, soon after menstruation ; the tumor is said to have swelled up during the menstrual period ; microscopically the gland tubules, which resembled the uterine glands, were filled with blood. For these reasons Cullen believes that adenomyoma of the round ligament develops from remnants of Müller's ducts, in contradistinction to von Recklinghausen, who maintains that this tumor, as well as his adenomyoma of the uterus, develops from the Wolffian body.

¹ Transactions of the Chicago Pathological Society, 1897, vol. ii. p. 300.

² Die Adenomyome u. Cystadenome des Uterus. Berlin, 1896.

³ Loc. cit.

⁴ Johns Hopkins Hospital Bulletin, 1898, p. 163.

⁵ American Journal of Obstetrics, 1898, vol. xxxvii. p. 37.

⁶ Further Remarks on Adenomyoma of the Round Ligament. Johns Hopkins Hospital Bulletin, 1892, vol. ix. p. 42.

INFECTIOUS DISEASES, INCLUDING CROUPOUS PNEUMONIA.

BY WILLIAM SYDNEY THAYER, M.D.

MALARIAL FEVER.

Etiology and Manner of Infection. During the last year interesting observations have been made bearing upon the etiology and manner of infection in the malarial fevers. Indeed there is reason to hope that in the near future the problem of the extra-corporeal existence of the malarial parasite and its manner of entrance into the body will be solved. Since the discovery in recent years of the fact that Texas fever and Nagana, or the Tsetse-fly disease, are transferred by means of suctorial insects, there has been a more or less general tendency among those particularly interested in the subject to return to the old idea that malarial fever may, in some instances at least, be transmitted by the bites of mosquitoes. Surgeon-Major Ross,¹ of the Indian medical service, has, within the last year, published some remarkable observations.

Following the suggestions of Manson, who has, as is well known, repeatedly advanced the hypothesis that the flagella of the malarial parasite represent bodies intended to preserve the life of the organism outside of the human body, Ross studied the behavior of the parasites in the blood within the stomach of mosquitoes fed upon infected human beings. In the tissues of the stomach-wall of several mosquitoes which had fed upon patients suffering with aestivo-autumnal fever, peculiar oval pigmented cells were found. The pigment was altogether like that in the malarial parasite, and these bodies were found only in several mosquitoes which had been fed upon the blood of malarial patients. Similar bodies were found on one occasion in the stomach of a gray mosquito which had been fed upon the blood of a patient with tertian malaria. Ross then proceeded to investigate the blood of birds, and succeeded in identifying the same varieties of parasites which had been previously described by

¹ Report on the Cultivation of *Proteosoma* Labbé in Gray Mosquitoes. Calcutta, 1898.

Labbé, Opie, MacCallum, and others. After feeding a particular variety of insect, which he termed the gray mosquito, upon the blood of birds containing mature proteosoma, Ross always found on the second day peculiar pigmented bodies embedded in the stomach-wall. The pigment contained in these elements appeared to be similar to that observed in the parasites previously present in the blood within the stomach. These bodies gradually grew until, on the sixth day or later, they reached a diameter of nearly 70 micromillimetres, the pigment in the mean-time disappearing. At this stage the bodies protruded from the wall of the stomach into the body cavity.

There were two varieties of these elements, one more or less hyaline, the other vacuolated. They both contained a certain number of small glistening fat-like drops. Within some of these older bodies he noted a peculiar striated appearance, while within others there were ten or eleven curious black sausage-shaped structures. That the appearance of these bodies depended upon the ingestion of infected blood was apparently beyond doubt. No such elements were ever found in mosquitoes fed upon non-infected individuals, while in repeated experiments Ross was able to trace the appearance of fresh groups after feeding upon infected birds.

He expresses his conviction in his first report that these studies go to prove Manson's theory that the mosquito is the intermediate host of the parasite.

Manson,¹ and later Ross,² give a most interesting account of further experiments in this direction. Ross noted that in some instances the coccidia-like elements, which were protruding from the stomach-wall into the body cavity, ruptured, setting free great numbers of minute spindle-shaped, somewhat flattened bodies from 12 to 16 μ in length by about 1 μ in breadth. This rupture occurs apparently on the eighth or ninth day. He was able to satisfy himself that it was to the presence of these that the striated appearance of the ripe "coccidium" was due. By examining the blood of mosquitoes at a time when such rupture might reasonably be supposed to have occurred, great numbers of these filaments were found in the circulation.

Further, Ross discovered a gland which has, apparently, heretofore escaped the notice of biologists. "This organ lies in the neck or anterior part of the thorax of the mosquito, and consists of a number of separate lobes. Each lobe is made up of numerous large cells clustered around a central duct and contained within a limiting membrane. The

¹ The Mosquito and the Malarial Parasite. British Medical Journal, 1898, vol. ii. p. 849.

² Preliminary Report on the Infection of Birds with Proteosoma by the Bites of Mosquitoes. Nowgong, Assam, October 11, 1898.

ducts of the several lobes ultimately unite and form a single main effluent. This runs up the under surface of the head in the middle line; enters the base of one of the stylets or lancets of the proboscis, namely, the central unpaired one, called the tongue or epipharynx; traverses the whole length of it and opens at its extremity in such a manner that the secretion of the gland must be poured into the very bottom of the wound made by the piercing apparatus of the proboscis." In many of the clear plump cells composing these glands, in mosquitoes which had been fed upon malarial blood and preserved a sufficient length of time for the coccidia-like bodies to ripen, Ross found a great accumulation of the thread-like elements. Their appearance is similar to that presented by the groups of bacilli in the lepra cell.

Suspecting that this organ represented a veneno-salivary gland, and that through its ducts the thread-like bodies, which he had come to believe might represent the infectious agent, might enter the bitten individual, Ross proceeded to interesting and apparently convincing experiments. Feeding mosquitoes on proteosoma-infected sparrows and keeping them more than a week until, as he knew from experience, the small rod-like bodies were present in the veneno-salivary glands, he allowed the insects to feed upon the blood of non-infected sparrows. The result of these experiments was most interesting.

In 22 out of 28 birds, after an incubation period of from five to nine days, the sparrows developed an intense infection, considerably more severe than he had previously observed when the source of infection was unknown. Indeed, in the majority of instances, the birds died, an unusual result. In four weaver birds and in one of two crows a similar result was obtained.

The function of the black "spores" is as yet unknown. While confirmatory researches remain to be made, Ross's experiments seem to have been carefully carried out, and appear to show that in infections with a parasite very closely allied to those of human malaria, the mosquito may not only play the part of an intermediate host, but, further, be the direct conveyer of infection by means of its bite.

If this be true with the proteosoma in birds, there is good reason to believe that similar conditions exist in connection with the malarial parasites of human beings.

It is interesting in this connection to note that Koch¹ expresses his conviction that this is an important and common means of infection. In his own words: "The more I study this disease, the more do I incline toward the opinion that the latter (method of infection), by means

¹ Arbeiten aus dem Kaiserlichen Gesundheitsamte, 1898, xiv. 239; also Reise-Berichte über Rinderpest, Bubonenpest in Indien und Afrika, Tsetseeder Surrakrankheit, Texasfieber, tropische Malaria, Schwarzwasserfieber. Berlin, 1898.

of the mosquito, is the main, probably the only, one. Wherever one goes he finds a relationship of both place and time between the presence of tropical malaria and the mosquito. On the coast there are several regions which have the reputation of being free from malaria, among which is the island Chole, which lies at the southern extremity of the large island Mafia. I have visited this island, which was formerly used by Zanzibar Arabs as a health resort. It is the only place on the coast where I was able to sleep without a mosquito net. In the mountains malaria comes to an end just where the mosquitoes disappear. As one passes inland, malaria and the mosquitoes disappear together. At those times of the year when there are many mosquitoes malaria is more severe."

One of the most interesting observations in this connection is that concerning the negroes of Usambara Mountain, who are frequently attacked by malarial fever when they come down to the lowlands. They call the malady "Mbu," and if one asks them how they have acquired the disease, they say that there were insects in the lowlands which are called by the same name as the disease, "Mbu"—that is, mosquito; that these had bitten them, and thus they have acquired the disease.

In Nuttall's¹ review of the subject, he states that Rübner has told him that this idea is popular in the southern Tyrol, while Lustig asserts that the same is true in Italy. Koch is particularly impressed, however, by the analogy between malaria and Texas fever, as well as other tropical diseases of men and beasts the parasites of which are found exclusively in the blood. In all of these diseases infection is conveyed by means of suctorial insects.

While Ross has been making his brilliant studies in India the Italians have not been idle. Dionisi² carefully examined the proboscides of mosquitoes, but was unable to find any bodies resembling parasites either on the proboscis or in the drop of saliva often present. He then determined the fact that mosquitoes do bite birds,³ provided any part is bared of feathers, and that in mosquitoes fed on infected birds the parasites rapidly become irrecognizable in the intestinal contents. He was unable to infect birds with mosquitoes from malarial regions. He notes, also, the interesting fact that the hæmatozoon infections in pigeons occur at

¹ Hygienischen Rundschau, 1898, vol. viii. p. 1084.

² Policlinico V.-M., 1898, 419.

* Ross does not state at what points his birds are attacked by mosquitoes. There is, however, nothing in his publications to suggest that any especial preparations need be taken to render the birds subject to attack. In this connection it may be interesting to note the observation of a friend of the reviewer that a pet canary was severely bitten *about the legs and feet* last summer. The legs were found to be much swollen and the bird appeared to be suffering. The cause of the condition was, however, not apparent until a mosquito was discovered in the act of biting. Protection by a netting was followed by speedy recovery.

just the period of moulting, a fact tending to support the theory of mosquito infection.

At the same time Grassi¹ has made some important researches concerning the relation of different varieties of mosquitoes and gnats to malarial infection. As a result of a careful study of the different varieties of mosquitoes observed in malarious and non-malarious localities, he has discovered three species of insect which are constantly found in malarious regions and are absent in healthy localities. The association of these three mosquitoes with malaria is so surprisingly definite and constant that the author asserts "that after all the facts which have been stated, all the objections which could be made to the mosquito theory fall, and we may, on the other hand, assert that it explains all the phenomena of malaria. . . ."

One of the varieties of mosquito, the *Anopheles claviger*, is, apparently, definitely associated, both in the localities in which it occurs and the time at which it bites, with tertian malaria, while the other two varieties, the *Culex penicillaris* and the *Culex malarie* (a new species so named by Grassi), occur apparently, invariably, in the localities and at the times of year in which the aestivo-autumnal fevers predominate. The author states: "In conclusion, I am of the opinion that the *Culex penicillaris* and the *Anopheles claviger*, at least the *Culex penicillaris*, perhaps also the *Culex malarie*, behave in malaria as does the tick in Texas fever. One must bear in mind that very few paludal gnats and mosquitoes ('Zanzare e zanzarone palustri') can be infected with malarial parasites, and in fact the greater part of them bite domestic animals (oxen, horses, hogs, dogs, pigeons, hens) and healthy men. It may be, therefore, that a single bite of a paludal mosquito or gnat ('Zanzarone o di zanzere palustri') may cause malarial infection, just as it may be that a myriad of bites may fail to cause it."

At the same time—independently of Grassi—Bignami² had started experiments to test the possibility of infection by the bites of mosquitoes collected from malarious districts. First a patient was exposed for several days to the bites of mosquitoes gathered at Porto; but as they were too scanty, he continued the experiment with two patients in a different manner. The mosquito larvæ were collected from the same region, and were allowed to develop in a chamber in which the patients were afterward exposed. The result was again negative. Later, hearing of Grassi's experiments, he obtained adult mosquitoes from Maccarese, a most malarious district, letting them loose in a room and allowing an individual to sleep in the same chamber, as a result of which he was frequently bitten. This patient was a young man who had never had

¹ Policlinico, 1898, V.-M., 469.

² Lancet, 1898, ii. 1461, 1541.

malaria in his life and had lived six years in the Santo Spirito Hospital where no autochthonous case of malaria had ever been known to develop. The patient slept in the room from September 26th until the last of October, though at various times there were but few mosquitoes present. On October 31st he had a slight elevation of temperature; on November 1st a chill, and afterward remittent fever up to the administration of quinine on November 3d. On the morning of November 3d characteristic æstivo-autumnal parasites were found in the blood. The author believes that infection from other sources than from mosquitoes can be absolutely ruled out.

Specimens of the mosquitoes from each batch were saved and examined by Grassi. All the mosquitoes examined from those hatched from larvæ were found to be of the species *Culex pipiens*, and, according to Grassi, "It may be taken for granted that when experiments were made with the mosquitoes hatched from larvæ collected in the Campagna the insects obtained would be the *Culex pipiens*, because the larvæ of this species are found in great swarms and, in consequence, are easy to collect; while larvæ of the other species are found with greater difficulty and not in swarms. One cannot absolutely exclude the possibility that infection occurred in one of the earlier periods, but it is not probable."

Specimens were sent to Grassi from every batch of the mosquitoes used in the last experiment, and among these he found the *Culex penicillaris*, the *Culex malariae*, and the *Anopheles claviger*; but this last only in one batch, and scanty in that. *In other words, the mosquitoes to which the positive infection appeared to have been due were exactly those varieties which Grassi had found to be associated with æstivo-autumnal malaria.*

Bignami then discusses the question as to whether malaria is contracted by inoculation only. "So much is certain, viz., that *inoculation is, up to the present, the only means for which experimental demonstration has been obtained.* . . . I believe it may be safely affirmed that all the facts known up to the present, regarding the biology of the parasites allied to those of malaria, favor the idea that infection is conveyed in only one way and introduced by only one method. . . . To sum up, malaria is a disease which is contracted by inoculation—a fact of which we have now obtained the first experimental proof, since we have seen that an individual, who has never had malarial fever, by sleeping in a healthy place where no one had ever previously taken fever, may sicken of malaria of a grave type if bitten by certain species of the mosquito brought in the adult state from some distant locality of highly malarious character. Further, everything points to the conclusion that inoculation is the only mode by which infection is acquired, since air and

water as carriers of infection may be excluded, and because arguments based on analogy all tend in the same direction. This much at any rate we can assert, namely, that inoculation is the only mechanism of infection which has been demonstrated experimentally."

Finally, Bastianelli, Bignami, and Grassi¹ have made a most interesting report upon the cultivation of the malarial crescents of man in the *Anopheles claviger*. They assert that they have positively followed certain phases of development of the semilunar bodies, in the wall of the middle intestine, of several specimens of the *Anopheles claviger* which had been fed on individuals suffering from æstivo-autumnal malaria. The most marked phases correspond to those described by Ross in his experiments with the proteosoma of birds (stage seen on the second and third day). They collected from a room in which four malarial patients, all probably suffering from æstivo-autumnal fever, were lying, six specimens of *Culex pipiens*, one *Anopheles nigripes*, four *Anopheles claviger*. In two of the last variety they found stages of further development corresponding to those of the fourth day found in the mosquitoes fed upon proteosoma by Ross. They believe that these mosquitoes are similar to Ross's dappled mosquito, in which he found stages of development similar to those of the proteosoma on the third day. Attempts to cultivate the parasites of owls and of pigeons in the *Anopheles claviger* were negative.

They note that in Lentini, in Sicily, last October and November, when there was still danger of malaria, neither the *Culex peicillaris* nor the *Culex malarie* were to be found, but the *Anopheles claviger* was, on the other hand, extraordinarily abundant.

And finally they note that they have obtained a characteristic double tertian malaria as a result of the bite of the *Anopheles claviger* (about 100 mosquitoes taken in the houses of Maccarese) in a man who was certainly not suffering from malaria and who lived in a non-malarious district.

They have, moreover, confirmed the results of the preceding cultures and have obtained further stages of development of the crescents in the intestinal walls of the *Anopheles claviger*.

"Moreover, in one individual of the same species, taken in a room inhabited by a man probably affected by æstivo-autumnal fever, there were found stages in which the process of sporulation was already advanced."

If we may accept these experiments of Bignami *et al.*, which, to say the least, are most suggestive, as positive proof of the inoculation theory of malaria, there remains yet the question as to how the infected

¹ Reale Accademia dei Lincei. Estratto dal vol. vii., 2^a sem, serie 5a, fasc. 11^o. Seduta del 4 dicembre, 1898.

mosquito has acquired the malarial parasite. Does the mosquito form an intermediate host for the parasite in man, as Ross has apparently shown to be the case in birds, and as is suggested by the last-mentioned observations, or do the larvæ possibly acquire the parasites outside of the human body, or, perhaps, may both of these conditions occur?

Not the least interesting feature of these observations, especially those of Ross, is the possibility which is suggested, that one individual infected with malaria may, through the intermediate action of mosquitoes, prove to be a more or less direct source of contagion to those about him.

CONGENITAL MALARIA. Bignami¹ discusses the question of the possibility of the existence of congenital malaria. He reports a new case of a woman who, having had frequent attacks of malarial fever during pregnancy, died in a pernicious paroxysm. While the maternal blood and organs showed the usual changes, yet the organs and blood of the fetus were quite normal.

In the absence of a single satisfactorily proven instance of the transmission of parasites from mother to fetus, he expresses his doubts as to the possibility of such an occurrence.

FLAGELLA OF MALARIA. Many important suggestions in connection with human malaria are contained in the valuable papers of Opie² and MacCallum.³ Of especial importance is the remarkable discovery of MacCallum, that in infections with the *halteridium* the flagella represent sexual elements. Certain of the flagella, after breaking loose from the mother body, may be observed to penetrate other parasites which later take on the form described by Danilevsky as the pseudo-vermiculus. MacCallum's conclusion, that this represents a process of fertilization probably the first step in another cycle of existence of the parasite, seems most probable. In two instances a similar penetration has been observed in human beings in cases of æstivo-autumnal malaria.

One of the most important results of this observation is that it would appear to settle the question as to the degenerate or non-degenerate nature of the flagella. *The flagella are certainly not degenerate elements.*

It is interesting in this connection that Bastiamelli⁴ has just published the results of careful studies of the minute anatomy of the crescentic and flagellate forms. He has been able to prove the fact that crescents do contain chromatin substance. The flagella arise probably from the nucleus of the parasite, and generally contain a central filament of

¹ Suppl. al Policlinico, 1898, vol. iv. 76 B.

² Journal of Experimental Medicine, 1898, vol. iii. p. 80.

³ Ibid., pp. 103, 117.

⁴ Lancet, 1898, vol. ii. p. 1620.

chromatin substance surrounded by a thin layer of protoplasm, prolonged to both extremities. Occasionally, where an isolated filament was found, it appeared as if the chromatin substance occupied the centre, while the two extremities consisted of protoplasm. Rarely filaments were found in which no evidence of chromatin substance could be made out. Bastianelli notes the fact that those who believe the flagellate bodies are not degenerate forms will hail this observation as a support for their theory. But he observes that it must not be considered irreconcilable with Bignami's oft-repeated opinion that the crescents from which these bodies develop are sterile elements *so long as they remain in the human body*.

Symptoms and Types of Fever. Solley and Carter¹ have made a careful study of eighty-seven cases of malarial fever occurring in New York City during the season of 1897. Tertian fever, as might be expected, is by far the commonest form in New York. They met, however, with several cases of æstivo-autumnal infection. No cases of quartan fever were studied.

Of 85 cases of tertian fever, 55 were single and 30 double infections. In several instances infections with the tertian parasite treated with quinine became irregular, and the authors point with justice to the fact that this is a not uncommon cause of more or less irregular fever in cases of infection with the tertian organisms. Their investigations lead them to conclude that this is due to partial destruction of the parasites present in the blood and to a derangement of their regular grouping. In one instance irregular fever was noted from the primary presence of multiple groups of parasites. The two instances of æstivo-autumnal fever which came under observation appear to have been cases in which the cycle of the parasite lasted approximately forty-eight hours.

Koch² comes to the conclusion that æstivo-autumnal fever occurs, as a rule, in tertian paroxysms.

Gautier³ has published a brief summary of his valuable work, *O parasite Laveran's*, which appeared in Moscow in 1896. He distinguishes three distinct varieties of fever and as many separate forms of the parasite, the tertian, the quartan, and a third organism corresponding to the æstivo-autumnal parasite, which he calls the *small two days' parasite*.⁴ In the sixty-two cases he failed to observe a quotidian form of æstivo-autumnal fever due to an organism whose cycle lasts twenty-four hours. Perhaps the most valuable part of Gautier's work consists

¹ The Malarial Fevers of New York City. Medical and Surgical Report of the Presbyterian Hospital in the City of New York, 1898, vol. iii. p. 89.

² Op. cit.

³ Zeitschr. f. Hyg. und Infectionskrankh., 1898, xxviii 439.

⁴ Gautier terms the quartan organism the "three-days' parasite," the tertian, the "two-days' parasite."

in a more careful study of the minute structure of the malarial parasite. Only part of the author's beautiful plates have been reproduced in the German publication. I have had the privilege of studying some of Gautier's own preparations, and can only state that, remarkable as are the reproductions, they fail to do justice to the originals.

Zieman, in his excellent work,¹ also distinguishes but three types of fever, and doubts the existence of more than one variety of the æstivo-autumnal parasite. In his own words: "At all events it is wisest, as we have already done, to include all the described small parasites for the present in a single group, though admitting variations in the length of the cycle of development from about twenty-four to forty-eight, possibly as much as seventy-two hours. Cases with a cycle of development shorter than twenty-four hours I have not seen." He agrees with Gautier and the reviewer in believing the usual cycle of the æstivo-autumnal parasite to be about forty-eight hours.

In view of the almost universal recognition of the existence of at least three types of the malarial parasite, the tertian, quartan, and the æstivo-autumnal or tropical organism, it is interesting to find that Laveran² still holds to his doctrine of the unity of the malarial parasite. After discussing the question as to the existence of a special parasite of tropical malarial fever, he concludes:

"1. In patients who have contracted paludism in tropical countries, and who have had relapses after their return to Europe, there are to be found in the blood the same parasites as in those who have contracted the fever in temperate climates.

"2. There is no special parasite which causes the malarial fevers in tropical countries.

"3. The differences in appearance which have been described by some observers between the hæmatozoon of the tropical countries and that of our climates depends chiefly on the fact that the parasite, finding in tropical countries a very favorable medium, has in newly infected subjects a more rapid evolution than in countries with a temperate climate. As soon as the conditions change the evolution of the parasite becomes normal."

M. A. Brown has studied twenty-eight cases of malarial fever occurring in the Cincinnati Hospital. Two of these instances were combined infections, one with both quartan and tertian parasites, one with tertian and æstivo-autumnal. The author insists upon the rarity of malaria originating in Cincinnati. He is of the belief that the great majority of these cases arise elsewhere.

¹ Ueber Malaria und andere Blutparasiten, etc. Jena, 1898.

² Archives de Parasitologie. Paris, January, 1898, t. 44.

Duggan¹ notes the difference between the æstivo-autumnal parasite as studied in West Africa and the ordinary tertian organism.

Daubler² was able to identify in East Africa two main varieties of parasites, the small (æstivo-autumnal organism) and the larger, more pigmented forms, the tertian and quartan organisms.

The æstivo-autumnal parasite has been found responsible for the greater part of the severe malaria contracted by our army in Cuba. Ewing, at Camp Wikoff,³ noted the fact that infections with more than two generations of parasites were rare. The cerebral type of malaria was common. He made the interesting observation, which has already been commented on by the Italian students, that after severe malaria the anemia and prostration may become steadily worse, even after the disappearance of the organisms from the blood. Ewing usually found numerous crescents in the comatose cases, and he is of the opinion that the coma is probably referable to some embolic process. In a considerable number of mild paroxysms with slight rise of temperature, associated with restlessness or vomiting, young crescents were found in abundance, leading him to suspect that the presence of these organisms was responsible for the occurrence of many of the acute phenomena of malaria.

Buckingham⁴ has studied 130 cases in the Boston City Hospital. He notes the fact that the absence of the chill in the paroxysm was rather the rule than the exception. Not infrequently comatose paroxysms, with fatal exit, were seen, the exacerbations occurring extremely suddenly. Dangerous paroxysms occurred in some instances after convalescence was apparently established. So frequent are relapses that the author states: "In private practice I should have it understood that if a man goes into the street unattended, within ten days of a severe manifestation of æstivo-autumnal malaria, he does it at his own risk. If he must go, it should be with an attendant prepared to inject quinine subcutaneously if necessary (!)."

Maxwell⁵ reports two cases in which epileptiform convulsions occurred during the supposed malarial paroxysms. The fever and convulsions disappeared immediately under quinine. No blood examinations were recorded.

Sequelæ and Complications. Considerable literature has appeared during the past year upon the so-called "malarial hæmoglobinuria" or hæmaturia. Koch⁶ studied sixteen cases of "black-water fever" in German East Africa, three of which, or 19 per cent., died. In two of these

¹ British Medical Journal, 1898, i. 139.

² Berlin. klin. Wochenschrift, 1898, xxv. 96, 123.

³ Medical Record, 1898, liv. 491.

⁴ Boston Medical and Surgical Journal, 1898, cxxxix. 433.

⁵ Medical News, 1898, lxxiii. 338.

⁶ Op. cit.

cases death occurred from obstruction of the urinary tubules by clotted hæmoglobin. In the third case death occurred during the attack from the excessive destruction of blood-corpuscles. In only two of these cases was Koch able to find the malarial parasite. He found no other organisms. In two instances, one of æstivo-autumnal and one of tertian malaria, the paroxysms followed closely upon the administration of quinine, and the other fourteen cases, Koch believes, "must in all probability be regarded as instances of quinine poisoning." He believes that there exists in these subjects an especial idiosyncrasy to quinine. Malaria, he thinks, was in most instances *not* responsible for the process, pigment having been absent from the liver and spleen in both cases which came to autopsy. It may be interesting to quote his own words: "Although I have met with no cases of black-water fever in which quinine poisoning is excluded, yet I should hesitate to go so far as to assert that every case of black-water fever is a quinine intoxication; but that quinine poisoning plays a very important rôle in the etiology of black-water fever is, as a result of my investigations, no longer to be denied. One must, in the future, decide before everything else in cases of black-water fever whether it is or is not a quinine intoxication, and, if this is to be positively shut out, whether other substances introduced into the body in some way or other, in food or drink, may not have an action similar to that of quinine. It is, however, readily conceivable that a man in whom this remarkable idiosyncrasy against quinine has developed, might react, with hæmoglobinuria, toward other substances which up to this time he has borne without ill effect.

"Only when such possibilities have been entirely shut out is it reasonable to investigate the remaining, possibly very small, number of cases of black-water fever with regard to other etiological possibilities. Moreover, it will also be very important to settle the question as to how the idiosyncrasy toward quinine arises in the tropics and whether it is not possible to remove this where it is present. It is probable, however, that this condition depends upon some appreciable changes in the constitution of the blood. In this connection it is certainly not an accident that black-water fever occurs almost only in men; women and natives are only exceptionally affected by it.

"If, however, it should be impossible to solve this riddle, this much is positive, that the treatment of black-water fever with quinine must absolutely cease, and that in patients with malaria who already have had an attack of black-water fever, quinine should be given with the greatest care, or, rather, should be replaced by other means."

Koch does not lay stress in his communication on the fact which is universally insisted upon by others, namely, that these tropical hæmoglobinurias are *always* or *almost always* preceded by repeated attacks of

malaria. He appears to think that the injudicious use of quinine as a prophylactic measure may, of itself, account for many instances of black-water fever.

Tsakyroglou¹ reports two cases of fatal hæmoglobinuria: one came on with the second, apparently malarial, paroxysm without any previous history of the disease, the other occurring, as usual, after repeated attacks. Both resulted fatally despite the use of quinine, and the author concludes that quinine plays no rôle in the pathogenesis or treatment of this disease.

Woldert,² in an article upon the use of quinine in malarial hæmoglobinuria, expresses his opinion that the drug has rarely any influence on the production of this symptom.

Clarac³ notes, as do nearly all authors, that in almost all, if not in all cases the hæmoglobinuric paroxysm is preceded by premonitory attacks of malarial fever. He has never seen hæmoglobinuria last more than five days, and if there was not total anuria, the gravity of the attack was in direct relation to the extent of the hæmoglobinuria, which in medium cases ends in three days. He has never seen intermittent hæmoglobinuria, and believes that this symptom may sometimes be due to quinine. He distinguishes three distinct types of hæmoglobinuria:

1. Endemic hæmoglobinuric fever.
2. Paroxysmal hæmoglobinuria.
3. Quinine hæmoglobinuria.

The first and third of these forms are always preceded by malarial attacks, and he is inclined to believe that preceding malaria may dispose toward paroxysmal hæmoglobinuria. He thinks, however, that it is unusual for actual acute malaria to be the direct exciting cause of an hæmoglobinuric attack, for hæmoglobinuria in Dakar is especially frequent between December and April—that is, at a time when paludism has begun to disappear or has disappeared. It is not, he says, “la plus haute manifestation du paludisme,” for if it were it should be more frequent at the time when the pernicious paroxysms are most common. He is inclined to believe that the season (cold) has a predisposing influence. He has never seen hæmoglobinuria in colored patients. In twenty-seven carefully studied cases he is positive of the important predisposing influence of malaria, but believes that this cannot explain all the cases. He acknowledges the possibility that the process may be due to a special variety of the parasite.

Doering⁴ met with 40 cases of black-water fever out of 169 cases of malarial fever in Kamerun.

¹ Allg. Wiener med. Ztg., xliii. 246.

² Medical News, 1898, lxxii. 547.

³ Ann. d'Hyg. et de Méd. col.; 1898, i. 9.

⁴ Arbeiten aus dem Kaiserlichen Gesundheitsamte, 1898, xiv. 121.

The chief condition favoring the development of black-water fever is a long residence in the tropics. In no case has he seen the disease occur inside of nine months. "Quinine in association with active malarial parasites has almost always been recognized as the important provocative cause of the outbreak of the disease. In several patients the blood had been already so much changed by residence in the tropics that, even without the presence of active plasmodia, quinine alone provoked a destruction of the red blood-corpuscles. In one case a simple malarial fever without apparent cause (without quinine) developed spontaneously into a black-water fever. In a number of patients, fever of one day's duration regularly occurring every three weeks, two weeks, or even every week, pointed to the imminent outbreak of black-water fever. In other cases the patients had been afebrile for six or even more months before the outbreak of the disease."

He sums up as follows :

"1. My observations agree with those of A. Plehn : in the beginning of black-water fever typical malarial plasmodia are almost always found, which disappear within a short period of time. I was unable to discover a special causal agent.

"2. In a woman who used quinine prophylaxis every five days, black urine appeared for a month and a half, regularly, three or four hours after the taking of quinine, at first without, later with, an elevation of temperature. I was unable to find plasmodia despite the most careful examination of the blood.

"3. In one case active plasmodia were still found in the blood on the fourth day after the outbreak of black-water fever. This was a case in which the action of quinine was excluded. It was, then, a black-water fever caused exclusively by the action of the plasmodia. Whether in such cases (black-water fever without quinine) it is judicious to adhere to treatment without quinine is a question for experience to settle. The quinine given by me¹ was without influence on the course of the disease."

All the cases were treated without quinine. Five of these patients died. The malarial parasites which are almost always present at the onset of the attack often rapidly disappear. "Through the destruction of the red blood-corpuscles in a paroxysm of black-water fever some substance is apparently set free in the blood which is capable of making the blood immune against malarial parasites for a certain length of time." This probably explains the fact that many cases after having recovered from such an attack remain free from malaria as much as six months or more. There are, however, cases in which relapses of uncomplicated malaria occur but a short period afterward.

¹ This quinine was administered on the ninth day of illness, when the patient was almost moribund.

The view that malarial hæmoglobinuria may be due to a separate and distinct form of parasite is suggested by Manson in his *Manual on Tropical Diseases*, and also by Dr. Sambon.¹

In most of this literature it is disappointing to find how unsatisfactory are the records of examinations of the blood. Any one who reads the communications upon malarial hæmoglobinuria which appear annually, particularly if he has had the good fortune to read Bastianelli's² admirable review of the subject, cannot fail to be impressed with the fact that hæmoglobinuria may stand in very varying relations to malarial infection. A predisposition to hæmoglobinuria may be acquired in various infections—typhoid fever, smallpox, yellow fever, and syphilis; that a similar predisposition may result from repeated malarial attacks is beyond question. It is also clearly demonstrated that many instances of hæmoglobinuria, beginning with a sharp initial chill and fever, occur in patients who, although they have suffered from malaria, are at that time quite free from acute infection. There can be no doubt that some of these instances of hæmoglobinuria occurring during or after a malarial attack, are actually provoked by quinine; such cases seem to be curiously common in certain, especially tropical, localities, and are very rare or unknown in other severely malarious districts and in most temperate regions. But it is equally certain that a large proportion of the so-called "malarial" hæmoglobinurias have no relation whatever to the taking of quinine.

What may be the direct exciting cause of many of these other instances of hæmoglobinuria, all of which are too apt to be included under the one heading of "malarial," is a question. The reviewer is not impressed with the evidence in favor of the dependence of these outbreaks upon a special variety of parasite. In the present condition of the subject it would seem to be possible to summarize in a few words as follows:

In certain severely malarious districts repeated infections result in the development of an individual predisposition toward hæmoglobinuria. In some instances the attack seems to be provoked by the actual malarial paroxysm. More commonly the outbreak occurs without relation to the existence of the symptoms of the predisposing disease, and often after it has ceased to exist. The immediate provoking cause is often impossible to determine. In some instances, particularly in certain tropical regions, the ingestion of quinine may provoke the hæmoglobinuric paroxysm.

OCULAR CHANGES. Bassères³ describes two cases of retinal hemorrhage in malarial fever, one of which was followed by a neuro-retinitis. He believes that the hemorrhage may be caused by:

¹ Journal of Tropical Medicine, 1898, i. 70. ² Annales de Médecine, 1896, ii. 847.

³ Arch. de Méd. et de Pharm. milit., 1898, xxxi. 336.

1. Embolism with pigment-bearing leucocytes or parasites.
2. Changes in the vascular walls due to anemia.
3. Toxaemia.

MENTAL CHANGES. Yammiris¹ describes several cases of mania or melancholia, developing in degenerates after malarial attacks. He believes that the malaria acted, in individuals predisposed to mental trouble, the part of an exciting cause. He cites, further, two instances in which symptoms of degeneracy followed paludism in individuals with a good family history, and he questions whether definite changes in the brain may not have been produced by the paludal infection.

RENAL CHANGES. Rem-Picci, in a valuable article,² discusses the occurrence of albuminuria and renal changes in malaria. He distinguishes two varieties of albuminuria, one a febrile albuminuria and one which occurs after the attack, during the post-malarial polyuria. The febrile albuminuria he found in 6 per cent. of the cases; it is transitory and mild. That which is post-malarial and accompanies the usual polyuria may last somewhat longer and be of greater intensity. There are, moreover, albuminurias which occur in the cachectic; these are also usually mild, but may be protracted for some time, disappearing, however, with the improvement in the general condition of the patient.

Malarial infection, however, may be associated not only with simple albuminuria, but with renal lesions indisputably dependent upon the disease. The kidney is not, according to Rem-Picci, particularly predisposed to injury in malaria, so that the occurrence of renal complications is rare. These occur more frequently in the fall than in the spring, and especially affect young individuals. They occur with the severe as well as with the mild forms of the disease, and are not more frequent in the former than in the latter. As a rule, the attack is subacute and accompanied by slight symptoms of a catarrhal, desquamative, tubular nephritis. Complete recovery occurs in the majority of instances; but under some circumstances, either from a recurrence of the fever or from lack of proper hygienic methods, or owing to individual conditions, an apparently mild attack may be the point of origin of a permanent lesion.

There occur also more severe acute nephritides, which may go on into a chronic form. All types of nephritis may be met with. There is apparently nothing specific in the nature of the renal changes, which appear to be of the same character as those in scarlet fever. Oedema is commonly present.

The renal symptoms may occur during the febrile period or afterward. To the latter cases Rem-Picci has applied the term "post-malarial,"

¹ *La Méd. Orient.*, 1898, ii. 6.

² *Policlinico V.-M.*, 1898, 197.

inasmuch as he believes it useful to draw especial attention to the fact that, with the disappearance of malarial fever, the possibility of a subsequent renal complication is to be borne in mind.

It is a question of doubt whether the most chronic forms of contracted kidney may be primarily caused by malaria. Amyloid changes may be complicated with the malarial nephritis. Finally, there occur rare instances of acute anasarca in malaria without albuminuria.

To these forms of malarial nephritis the changes in the kidney which occur in instances of hæmoglobinuria are indirectly related.

The pathogenesis of these malarial nephritides is doubtless to be sought for in the elimination of toxic substances.

The reviewer¹ has also made a series of investigations upon the subject of nephritis of malarial origin. In 758 cases of malarial fever treated in the wards of the Johns Hopkins Hospital, albuminuria occurred in 46.4 per cent., and casts of the urinary tubules in 17.5 per cent.

Albuminuria was much more frequent in æstivo-autumnal fever than in the regularly intermittent fevers, occurring in but 38.6 per cent. of the latter and in 58.3 per cent. of the former, while casts of the renal tubules were found in 12.2 per cent. of tertian and quartan infections, and in 24.7 per cent. of the cases of æstivo-autumnal fever.

The frequency of albuminuria in æstivo-autumnal fever is apparently equal to that in diphtheria, though less than in scarlet and typhoid fevers.

Out of 1832 cases of malarial fever in the hospital and in the outpatient department there were 26 instances of nephritis of malarial origin, or 1.7 per cent. Of these 13 recovered, 4 died, and in 9 the result was doubtful, 3 instances probably becoming chronic. In three of the fatal cases there is possible doubt as to the malarial nature of the case.

Nephritis occurs, apparently, in from 1 to 2 per cent. of all cases of malarial fever in the neighborhood of Baltimore. The complication is more frequent and severe in the æstivo-autumnal fever; it is commonest during the height of the malarial season, in July, August, September, and October; it is rare in the first half of the year.

The relative frequency of malarial nephritis appears to be much greater in the negro than in the white race.

There is nothing especially distinctive in the clinical characters of the disease. It shows the usual features of an acute toxic nephritis, and the tendency is apparently toward a short course and a favorable issue. Severe, fatal, or chronic forms of the disease may, however, occur—two, possibly four, instances of chronic nephritis of malarial origin having come under our observation. Conclusions:

¹ Transactions of the Association of American Physicians, 1898, xiii. 339, and American Journal of the Medical Sciences, 1898, cxvi. 560, 646.

1. Albuminuria is a frequent occurrence in the malarial fevers of Baltimore, occurring in 46.4 per cent. of our cases.

2. It is considerably more frequent in æstivo-autumnal infections, occurring in 58.3 per cent. of these instances, against 38.6 per cent. in the regularly intermittent fevers.

3. Acute nephritis is a not unusual complication of malarial fever, having occurred in over 2 per cent. of the cases treated in the wards of the Johns Hopkins Hospital, and in between 1 and 2 per cent. of all cases seen at the institution.

4. The frequency of acute nephritis in æstivo-autumnal fever is much greater than in the regularly intermittent fevers, having been observed in 4.7 per cent. of the cases treated in our wards, and in 2.3 per cent. of all the cases seen.

5. The frequency of albuminuria and nephritis in malarial fever, while somewhat below that observed in the more severe acute infections, such as typhoid fever, scarlet fever, and diphtheria, is yet considerable.

6. There is reason to believe that malarial infection, especially in the more tropical countries, may play an appreciable part in the etiology of chronic renal disease.

ABORTION. Dock¹ relates a case of abortion at three months, following an attack of double tertian malaria, which may possibly have been due to the high fever. There was no evidence of foetal or placental infection.

TYPHOID FEVER. The campaign in Cuba, as well as the unhygienic condition of the camps in the South, has afforded an excellent opportunity for the study of combined infections of typhoid and malarial fever, and in all probability we may expect valuable observations. Ewing,² at Camp Wickoff, found the malarial parasites in the blood of five cases of typhoid fever in acute exacerbations occurring during convalescence. From these observations he draws the following conclusions:

1. Mixed infection of typhoid and malarial fever undoubtedly exists.

2. When typhoid develops in a case of active malaria the malarial element nearly always becomes quiescent and has little or no effect on the course of typhoid fever. Malarial infection frequently outlasts the typhoid infection, and makes itself manifest during convalescence. In no undoubted case of typhoid fever, in which the diagnosis was confirmed by autopsy, was the malarial organism found.

Dr. Park, in the discussion of this communication, states that from inquiry as to the experience of various hospitals in New York City he found that the malarial organisms had been found in the blood in from 1 to 5 per cent. of the typhoid cases in all but one hospital.

¹ Philadelphia Medical Journal, 1898, i. 699.

² See Typhoid Fever, p. 308.

Kardamatis and Canellis¹ discuss the continued malarial fevers and typhoid fever in Greece, and, though themselves offering no direct evidence, reach the conclusion that typhoid fever and malaria often occur simultaneously. There is no antagonism between the diseases, as was believed by Boudin. They recognize the fact that this association is a simple complication of diseases, and that there is no such disease entity as "typho-malarial fever."

Nammack,² in a clear article on the differential diagnosis and treatment of Cuban and camp fevers, states: "We found no reason to recognize a distinct type of continued fever which is neither malarial nor typhoid, or one which is a compound of both, the so-called typho-malarial fever." Several cases of mixed infection were found. "As a rule, in these cases of mixed infections the activity of the malarial plasmodium was shown early in the course of the typhoid diseases. In one very interesting case, however, . . . characteristic chills developed after convalescence from typhoid." "In every case of differential diagnosis between malarial fever and typhoid, the final decision was reached by examination of the blood, and in no case was it necessary to employ the therapeutic test of quinine."

It is interesting to see that the observers who have adopted scientific methods of diagnosis unanimously repudiate the erroneous ideas which have been so long held, and are, alas, still held, with regard to the existence of a special disease entity—"typho-malarial fever." The results of careful studies of combined typhoid and malarial infections, from the development of which such rare opportunities existed during the recent campaign, should shed much light upon the disputed question as to whether the complication of these two affections results in a particularly characteristic disease picture.

MISCELLANEOUS. Norton³ has contributed a valuable paper upon malaria as a causative factor in other diseases. In a careful study of the literature he demonstrates how recklessly maladies of every description have been ascribed to malarial infection, and how few of these, after all, are positively proven to be truly malarial in nature. He reaches the following reasonable conclusions: "In making a short review of what has gone before there are several deductions which can be drawn:

"First, and foremost, that malaria is not the cause of so many evils as are attributed to it; secondly, that its favorite seats of attack after the blood and blood-making organs are the gastro-intestinal and central nervous systems, and that other organs and systems are but rarely affected;

¹ *Le Progrès Médical*, 1898, 3 s., vii. 195, 260, 276.

² *Medical Record*, 1898, liv. 471.

³ *American Journal of the Medical Sciences*, 1898, cxv. 161.

thirdly, and not the least important, that the cases supposed to be malaria should, in the future, be more carefully studied, and that hereafter it should not be given as a cause of existing evils without sufficient and abundant proof. If the blood cannot be examined, then only a full history of the case should be accepted in which the fever, spleen, and effects of treatment are carefully noted."

Bartolucci¹ reports a case of pernicious malarial fever with *pulmonary manifestations*. The absence, however, of blood examinations renders the diagnosis inconclusive.

Diagnosis. **METHODS OF STAINING.** Ziemann² deals at length with modifications of Romanovsky's valuable method of staining with eosin and methylene-blue, which are particularly fitted to bring out in a satisfactory manner the finer structure of the malarial parasites. It would be impossible in an article of this nature to go into the subject at length; reference should be made to Ziemann's excellent work.

Futcher³ has called attention to an extremely valuable method of using thionin as a stain for the malarial parasites. Upon a dried cover-glass specimen a little of a 1 per cent. solution of formalin in 90 per cent. alcohol is poured and allowed to remain for one-half to one minute. The specimen is dried between leaves of filter-paper; absolute alcohol is then poured over the glass, which is once more dried, and then stained for twenty to thirty seconds in Marchand's solution of phenol thionin, which is prepared as follows:

Saturated solution of thionin in 50 per cent. alcohol	20
2 per cent. solution of ac. carbol.	100

The solution must stand several days.

The specimen is then washed in water, dried between filter-paper, and mounted in balsam. If the specimen has not been stained too long the corpuscles take a very slight greenish hue, while the parasites are of a deep violet color. The specimen should not be stained too long, as in pigmented parasites granules of pigment may be obscured by the depth of the color. This method is particularly valuable in that it brings out with great clearness the small, ring-shaped hyaline bodies of æstivo-autumnal fever with their chromatin dot. The chief value of this stain, however, is its readiness of application, which renders it particularly useful to the busy general practitioner.

ENLARGED SPLEEN. Koplik⁴ asserts that in children enlargement of the spleen is of little diagnostic value without corroborative examination of the blood. Fairly severe cases of tertian malaria occur in chil-

¹ Gaz. d. osp., 1898, xix, 1032.

² Op. cit.

³ Remarks, as yet unpublished, at the Johns Hopkins Hospital Medical Society.

⁴ Medical Record, 1898, liii, 209.

dren without enlargement of the spleen, and many cases in which the spleen is enlarged are not malarial.

Treatment. QUININE. There is little new to be said with regard to the use of quinine in the ordinary manifestations of malaria.

Van Marter¹ denies its value excepting in the regularly intermittent forms, but he publishes no charts and quotes no cases to prove that continued fevers in which he has failed to obtain good results are purely malarial in nature. He also asserts that it should never be used in hæmoglobinuria.

Row,² of India, asserts that in the severe fevers of India he never has to give more than 15 grains of quinine at one dose. This he usually administers just when fever begins to subside. He then gives sulphate of quinine, gr. x to xv, and afterward gr. v every four, five, or six hours, often not more than four times a day, for a week at least, after which he continues quinine in 2-grain doses with Fowler's solution, gtt. iv to v, twice a day for a fortnight. Relapses rarely occur. Out of many cases he had but five or six, and in these instances the relapses rapidly yielded to quinine. Ten grains is his usual initial dose for an adult.

Gilbert³ also testifies to the specific action of quinine.

Ziemann⁴ recommends very highly the intramuscular injection of quinine. He inserts the quinine into the glutei, using as the usual dose bimuriate of quinine 0.5 (grs. vij) to 2 grammes (℥ xxx) of water. The proportion of quinine to the fluid should be about 1 : 4. In higher proportion the injections are painful, while with this they are almost absolutely painless. The action is most prompt, and the author believes that it is the most satisfactory method of giving quinine. He has never seen any unpleasant results.

EUCHININ. Considerable attention has been paid during the last year to a new, tasteless product, euchinin, which is an ethyl carbonate of quinine.

St. George Gray⁵ is enthusiastic over its action, asserting that, beside its great superiority over quinine in being tasteless, it reduces the temperature in smaller doses. It does, however, cause tinnitus aurium, deafness, and derangement of vision in more marked degree than the same dose of quinine. "Contrary to the statement of Professor von Noorden, that 15 grains of quinine are equal to 25 or 35 grains of euchinin as an antipyretic, 15 grains of euchinin are as efficacious as 20 to 30 grains of quinine sulphate." In doses of 12 to 15 grains it almost always causes buzzing in the ears, if not other symptoms of cin-

¹ Texas Courier of Medicine, 1898, xv, 316.

² New York Medical Journal, 1898, lxxvii, 94.

³ Journal of the American Medical Association, 1898, xxxi, 1162.

⁴ Loc. cit.

⁵ British Medical Journal, 1898, i, 551.

chonism. He has never given a larger dose than 15 grains. Unfortunately, he reports no blood examinations, but the cases in the West Indies which he studied were in all probability malaria. He administers the drug as a simple powder placed dry upon the tongue. He concludes that :

1. Euchinin is as efficacious as quinine in malarial fever.
2. It causes cinchonism.
3. It is tasteless and, therefore, easily administered.

This last point is a great advantage over quinine.

Mori¹ studied the effects of the drug in fourteen cases of various nature, and in twenty instances of malaria. Taken by the mouth in doses of 0.25 to 1. (gr. iijss to xv) it produces no disturbances in adults. In anemic individuals and those in whom the stomach is a *locus minoris resistentiæ* a dose of 2. to 3. (gr. xxx to xlv) causes a sense of weight in the epigastrium, a slight pyrosis, nausea, eructations, vomiting, and loss of appetite if continued. It has apparently no influence on the intestine. Panegrossi found that elimination, which begins in half an hour, reaches its maximum in seven hours and is concluded in forty-eight hours. The nervous symptoms are like those following quinine, but shorter and less intense—*i. e.*, heaviness in the head, deafness, buzzing and singing in the ears. He has never seen changes in vision. Doses of 3. (gr. xlv) in healthy adults result in a slight increase in the frequency of the heart-beat and an increase in the quantity of urine. In twenty cases of malaria the results of his treatment were satisfactory. He usually gave a gramme at a dose, six, four, and two hours before expected attacks, and then continued the administration of the drug for five or six days following, reducing the daily dose gradually to 0.5. Under these circumstances the subjective symptoms were slight and never resulted in characteristic cinchonism. Ringing in the ears was the most common symptom. The more severe symptoms mentioned above sometimes occurred in feeble individuals with gastro-intestinal trouble : pyrosis, weight in the stomach, nausea, eructations, and vomiting may occur. These, however, diminish under continuation of the treatment. His best results were obtained in children, in the treatment of which he believes the drug to be especially valuable.

Sukhomlin² tested the value of euchinin in eleven instances of malarial intermittent fever. A distinct antimalarial action was noted ; but given in doses equal to the ordinary doses of quinine the effect was not as good, the results being obtained considerably more slowly. The author notes the possibility that larger doses might have had a materially better effect.

¹ La Sett Med. d. speriment, Firenze, 1898, lii. 396.

² Ejened. journ. "Pract. med." St. Petersburg, 1898, v. 297.

Zangri and Peratoner,¹ from observations in Tomaselli's clinic, conclude that euchinin is of great efficacy in malarial fevers, being equal to the best preparations of quinine known at present.

In some cases in which quinine had not promptly stopped the fever, euchinin was efficacious in accomplishing this result. The observers insist that as much as 6 grammes must always be given before the complete disappearance of the fever. Single doses were apparently below 1 gramme. In no case were there disturbances of any sort, gastric or other. With the larger doses the patients complained of a slight buzzing in the ears. The new drug will occupy an important place in therapy if future experience shows that it may be borne in cases of quinine intoxication.

Lewkowiez² used euchinin in sixteen cases, six of which were tertian, four malignant malarial fever, and six quartan ague. The drug acted promptly and without failure in all cases. Large doses of the drug, 1. (gr. xv), twice in the day, are well borne through a long time, while by small doses administered through a long period complete cure is to be obtained in young individuals. The author observed in the parasites the characteristic alterations which occur after the use of quinine. He administered the drug in capsules: it may be given to children in different substances—water, milk, coffee, etc. He observed unpleasant phenomena (buzzing in the ears and the symptoms characteristic of quinine intoxication) only twice, and then when large doses were used corresponding to about 2.5 for an adult.

Goniox³ reports concerning six months' observations on the efficacy of euchinin in various diseases. These observations were made on one hundred patients in his private practice in Tiflis, patients suffering with diseases for which ordinarily he would have given quinine. He is convinced that euchinin acts very well in those diseases in which the use of quinine is indicated, and in addition it has the advantage of being more easily taken by the patient, owing to the absence of any bitter taste. In children vomiting is much more rare after euchinin than after quinine. The curative action of euchinin "was exactly as positive as that of quinine in all cases of malarial fevers." He considers the preparation of particular value when dealing with children. To obtain its full action it is necessary to give it in larger doses than quinine, inasmuch as its action is weaker. Thus, in malarial fevers, he gave to adults up to 15 grains at a dose, four hours before the attack; to children of four or five years of age, up to 5 grains in the twenty-four hours (in place of 3 grains of quinine), thus regulating his doses according to age. The dose of euchinin should be somewhat less than twice the dose of quinine. Thirty of the one hundred patients with whom he used quinine had

¹ *Riforma Medica*, 1898, xiv. iii. 62.

² *Wien. klin. Wochenschrift*, 1898, xi. 922.

³ *Vruch*, 1898, xix. 776.

malarial fever. Several of these had the usual symptoms which follow quinine—roaring in the ears, itching, and slight vertigo, with very large doses.

The reviewer has seen good results from its use in two cases.

These reports justify a more general test of this new drug. It will be unquestionably a material addition to medicine if the preparation proves to be as efficacious, while free from unpleasant taste, as quinine.

PHENOCOLL, ANALGIN, ETC. All observations go to show that these drugs have but little real antimalarial action. Lewkowicz, as well as Ziemann,¹ sharply emphasize their relative inefficiency.

CHINOPIRIN. Laveran and Gessard have advised the following mixture for hypodermic injections in malaria:

Hydrochlorate of quinine	3.
Antipyrine	2.
Distilled water	6.

Antipyrine appears to increase the solubility of quinine, and according to Santesson, a new, easily soluble combination of quinine and antipyrine results, to which he has given the name of chinopirin. Doses, however, of 0.5 (gr. viij) of quinine with 0.3 (gr. ivss) of antipyrine have been followed by unpleasant symptoms. Introduced hypodermatically doses twice as large may be used. Lewkowicz used the substance hypodermatically in four instances with good results, giving a boy eight and a half years of age two injections of 1 c.c. of the mixture. The seat of injection may often be painful for some little time afterward, but the effects are excellent.

MYRRH. Jeffrey² states that he has been in the habit, in the treatment of malaria, of adding small quantities of myrrh to quinine, believing that the efficaciousness of the latter drug is materially increased. He adds 1 grain of myrrh to 1 grain of quinine in capsules.

ERGOT. Jacobi³ asserts that in chronic malaria with enlarged spleen ergot is a valuable therapeutic agent.

Treatment of Sequelæ and Complications. NEPHRITIS. In the treatment of nephritis of malarial origin, both Rem-Picci and the reviewer insist upon the necessity of treatment with quinine whenever active malaria exists. Quinine removes the malarial infection, which is the cause of the complication, and recovery, as a rule, follows. Further treatment should be directed toward the nephritis as such, which differs in no way from any other toxic nephritis.

ANEMIA. Brown⁴ believes, as a result of his experience, that arsenic has little effect in post-malarial anemia if not accompanied by iron.

¹ Loc. cit.

² Medical News, 1898, lxxiii. 513.

³ Medical Record, 1898, liv. 268.

⁴ Loc. cit.

SPLENOMEGALY. Laccetti,¹ discussing the treatment of post-malarial splenomegaly, asserts that simple congestive splenomegaly is influenced by quinine and the "ordinary vaso-constrictors (arsenic, strychnine, ergotine, hydrotherapeutics, electricity)." In cases of chronic splenic enlargement with marked interstitial changes, however, especially where the spleen is movable and causes distressing symptoms, one must resort to splenectomy.

Laccetti relates a case in which, six days after splenectomy, there occurred intermittent fever, which disappeared after the administration of quinine. After the operation there was pain in the diaphyses of the long bones, which the author believes to have been caused by the vicarious activity of the marrow.

HEMOGLOBINURIA. As might be expected from the fact that under the heading of "malarial hæmoglobinuria" several different conditions are considered, the opinions of different authors as to its treatment vary materially.

Koch² protests against the employment of quinine in black-water fever, asserting that its injudicious use as a prophylactic is, in most instances, responsible for the outbreak of the disease.

Van Marter³ likewise insists upon the danger of the use of the drug.

Tsakyroglou⁴ asserts that quinine plays no rôle in the pathogenesis and treatment of this disease (black-water fever).

Woldert⁵ doubts the existence of quinine hæmoglobinuria, and insists upon the use of quinine.

Denman⁶ asserts that malarial hæmaturia is most apt to occur in cases of malaria which have been neglected or not properly treated in the beginning, never as a result of quinine, but because quinine has not been given at the time when it, and it alone, could have arrested the process of the malarial infection. He has studied nineteen cases. "Unless the case shows a damaged state of the blood and kidneys sufficient to cause uremia, I administer quinine and push it to cinchonism as rapidly as I can, to insure cutting off the next chill, no matter how much blood may be passing by the kidneys." In addition he usually gives calomel, strychnine, nitroglycerin, and sometimes pilocarpin.

Murdock⁷ makes some very sensible observations which may well account for many of the reports of the negative value of quinine. He recognizes the fact that the predisposing cause of the so-called malarial hæmaturias is malaria, but he believes that in nearly all the cases malaria has ceased to exist, and, therefore, plays no part, or at least a minor part,

¹ Giorn. internaz. della sc. med., 1898, fasc. i.

² Loc. cit.

³ Loc. cit.

⁴ Loc. cit.

⁵ Loc. cit.

⁶ Texas Medical Journal, 1898, xxiii, 501.

⁷ Journal of the Mississippi Medical Association, Biloxi, 1898-9, ii, 111.

in the condition present when hæmaturia makes its appearance. In the treatment of his cases, all of which have been of this nature, he gives, in the beginning, calomel, gr. x to xv, and turpentine, gtt. x. After the calomel has acted well he gives tincture of chloride of iron, gtt. x to xx, every four hours. When the urine loses its dark color and begins to become more or less red, he stops the turpentine and gives fluid extract of ergot and acetate of potassium or spirit of nitre, and on convalescence he gives arsenic and strychnine.

Clarac,¹ speaking with regard to the treatment of hæmoglobinuric fever in Dakar, in Africa, recognizes the fact that few of the hæmoglobinurias occur during the active malarial attack, though in most this has been the predisposing cause. He continues, "Quinine, even in strong doses, is useful at the time of the paroxysms which precede the hæmoglobinuria, and is always taken by the patient. Medication seems to us useless when the temperature has fallen; on the contrary, if fever persists one should pursue the elevations of temperature by moderate but sufficient doses of quinine, administered as far as possible hypodermatically, to arrest the destructive action of the hæmatozoon and to prevent succeeding attacks. We have been able to make out that the recrudescences of fever or the augmentation of the temperature resulted almost always in a diminution in the number of red corpuseles, an observation agreeing with the researches of Kelsch and Kiener." The salts of quinine are contraindicated when there is anuria. He is inclined to believe that 4. (5j) to 6. (5jss) of chloroform in twenty-four hours, taken in the form of chloroform-water, has a certain value. The other treatment is symptomatic.

Doering² does not use quinine in the treatment of his hæmoglobinurias.

As has been mentioned before, he notes the fact that in some instances the attack of black-water fever itself seems to produce a spontaneous disappearance of the malarial parasites and of the symptoms of the disease. But if the relapses of malaria occur shortly afterward, without black-water fever, it is absolutely necessary to treat these with quinine. Small doses are often sufficient. "As a result of my experience I cannot lay enough stress upon the warning not to attempt to allow these malarial attacks, coming on shortly after a recovery from an attack of black-water fever, to heal without quinine. I would rather risk—if plasmodia are found—bringing on another attack of black-water fever by quinine than to allow the patient to die without having given him quinine.

"Many an individual who would yet have happily escaped the dangers of the Kamerun climate has fallen a prey to an uncomplicated malarial attack as a result of his refusal of quinine, for fear of a fresh attack of black-water fever."

¹ Loc. cit.

² Loc. cit.

In those cases where the attack comes on without the influence of quinine, parasites remaining in the blood, the question as to the advisability of the administration of quinine remains for experience to settle.

The reviewer cannot resist adding a few words, largely a repetition of what he has previously printed upon this subject. It is inconceivable that intelligent physicians should give such diametrically opposite reports as to the efficacy of quinine, and its possible deleterious effects, as are constantly received from different parts of the world, if they are dealing with exactly the same condition. Scientific observation of cases and the use of the microscope in diagnosis have shown that malaria frequently plays only a predisposing part toward this condition; that when present it is absolutely necessary that steps should be taken to remove the infection, and when not present there is no earthly reason for giving quinine, while the fact that in certain regions quinine may act as an exciting cause of hæmoglobinuria should be enough to make us cautious in our use of the drug where it is not necessary. In a word: (1) if the hæmoglobinuric attack has come on without quinine, and there are active parasites in the blood, quinine must certainly be administered. (2) If under the same circumstances parasites are absent, quinine is uncalled for. (3) If there is reason to believe that the attack has been precipitated by quinine, the drug should certainly be stopped, unless evidences of a very severe infection continue. The quinine already given, together with the destructive action of the attack, will probably be enough in most cases to overcome the infection. To properly treat "malarial hæmoglobinuria" the microscope is indispensable. Koch puts it as follows: "For this reason alone, but especially in order to establish an early and sure diagnosis, the microscope is absolutely indispensable to the physician in the tropics, if he has much to do with malaria, and that is probably always the case. A physician who faces malaria without a microscope and without thorough practice in the detection of malarial parasites will always fight in the dark."

Prophylaxis. Koch¹ found that quinine, 0.5 (gr. viij), taken every other day, was sufficient in most instances to ward off attacks of fever; he believes that 0.5 (gr. viij) every fifth day, as advised by Plehn, is scarcely sufficient. As a purely prophylactic means, he hesitates to advise more, inasmuch as "larger doses of quinine are ill-borne through a long period of time."

Doering,² in Kamerun, used quinine, 0.5 (gr. viij), every fifth day, as advised by Plehn. His results were not quite as favorable with regard to ordinary malarial attacks as were Plehn's, although he feels that as yet his observations have not been sufficient to arrive at a positive conclusion.

¹ Loc. cit.

² Arbeiten aus dem Kaiserlichen Gesundheitsamte, 1898, xiv. 121.

He is, however, particularly impressed with the favorable influence which quinine prophylaxis, regularly carried out, has upon the development of black-water fever. This, he thinks, is due not only to the warding off of repeated malarial attacks, the predisposing influence of which is generally recognized, but to the fact that, "if one accustoms the blood regularly during the afebrile period to quinine, then the irritation which quinine exercises upon the red blood-corpuscles during the fever is appreciably less, and the quinine is much less likely to produce a destruction of the red blood-corpuscles than when the blood has not become regularly accustomed to the drug. Therefore, it would seem wise to use quinine prophylaxis wherever one has to remain for a considerable length of time in the tropics, even when the danger of black-water fever is not suggested by regular, continually recurring fever. . . .

"The predisposition to black-water fever is not dispelled by a long sojourn in Europe; therefore, whoever returns for a second time to Kamerun, should institute quinine prophylaxis as soon as he steps upon African ground."

TYPHOID FEVER.

Etiology and Manner of Infection. THE EFFECTS OF TYPHOID "TOXIN" ON ANIMALS. Lépine and Lyonnet¹ have studied the effect upon dogs of injections of typhoid "toxin" prepared by heating a culture of the bacillus at 58° C. They arrive at the following conclusions:

1. There are rather marked individual differences in dogs in relation to their resistance to the action of typhoid toxin. The fatal dose by kilogramme varies from a minimum to four to five times that amount, "du simple au quintuple."

2. Removal of the spleen, if it be done immediately before injection of the toxin, appears to exercise no appreciable influence.

3. If this organ be artificially heated, a proceeding which increases its vitality, one may bring about the survival of dogs intoxicated by a dose of the toxin which would otherwise be surely fatal.

4. Generally, when new dogs succumb rapidly to an injection of toxin, their temperature becomes very little elevated, or even falls; on the contrary, if they resist, there is a rapid and often a considerable elevation of temperature.

5. With regard to the leucocytes, it may be said that if the dog succumb rapidly to infection with typhoid toxin, his colorless corpuscles undergo a marked diminution; on the contrary, if he succumb slowly, his leucocytes do not diminish at all, but increase slightly; if he resist they increase either a few hours after the injection or on the following day.

¹ Revue de Médecine, 1898, xviii. 854.

Rodet¹ noted that filtered cultures of the typhoid organism resulted in local and general troubles very similar to those produced by cultures killed by heat. They differ only in that they do not produce suppuration. The soluble products favor the infective action of bacilli. The filtered cultures are, moreover, possessed of an immunizing power and of an agglutinative property.

THE RÔLE OF CONTAGION. Annequin² takes up the question of the contagiousness of typhoid fever. The strongest argument in favor of contagion appears to him to be its frequency among the nurses in military hospitals. Inasmuch as they are not exposed to the various injurious influences which elsewhere may come into play—water, food, etc.—their disease may be ascribed exclusively to contagion. The morbidity from typhoid fever in the French army is about 1.07 per cent., while that of the nurses in the garrison hospitals amounts to 9 per cent., and, indeed, in the epidemic of 1882 it was as high as 23 per cent. The statistics of other armies give similar figures. Annequin has also studied contagion among the patients, and believes that it occurs chiefly by direct contact with the affected individual and everything that he soils. The hands and clothing of those who surround him may also convey the contagion. The air may assist either directly through the respiratory passages or by depositing substances on articles of food or drink. With the nurses the chief danger is probably negligence in cleanliness and anti-sepsis, mainly neglecting to wash their hands before eating. With patients the most frequent cause of contagion is promiscuous use of utensils, respiration of dust, and contact with the *personnel* of the hospital who are handling typhoid patients. The conclusions, though rather sweeping, are none the less interesting:

“1. It is necessary to isolate typhoid patients, or at least not to place them in a ward containing young people who have not previously had typhoid fever.

“2. One should, if possible, employ as nurses individuals who have already had typhoid fever. In a family one should remove young people.

“3. Everything which has been in contact with the patient and could have been soiled by his excreta should be rigorously disinfected. The linen of the patient should not be thrown upon the floor but put in a metal box.

“4. The chamber should be oiled, its floor impermeable, so that it may be cleaned with a cloth damp with antiseptic solution, to avoid the formation of dust.

“5. The nurses should wear in the room special linen clothes, which they should remove when they go out. They should take care not to

¹ La presse médicale, 1898, Ann. vi. t. i. 247.

² Lyon méd., 1898, lxxxvii. 181.

sit upon the bed nor drink and eat in the sick-room. The hands should be kept perfectly clean.

"6. If the patients with typhoid fever are isolated in special rooms these should be large and well aired; every patient should have two beds.

"7. The bringing together of patients in a single room does not aggravate their condition, a conclusion arrived at in Grenoble from 1891 to 1897. The patients enjoy repose and silence, of which they have so much need. The organization of the service and the administration of the baths are more easy, and if the dangers of contagion are increased for the nurses, they are diminished for the other patients."

Antonin¹ has studied a severe epidemic of typhoid fever which occurred among the civil and military inhabitants of Bucharest. Out of 300 pupils in the military school, 26 were affected, with 3 deaths; while out of 132 soldiers but 2 suffered. This disproportion is well explained by the grouping of the pupils in one part of the building, notwithstanding the fact that the hygienic conditions in other respects were better than those endured by the soldiers. Inasmuch as the pupils and soldiers drank the same water, which after the development of the epidemic was boiled, the origin of the disease from water may be ruled out. Indeed, there are no facts in relation to the epidemic which suggest that this was the case. Typhoid had never before occurred in the school, and arose on this occasion only after the pupils came, disappearing when they left. The most interesting point is that the greater number of cases was observed in two dormitories, where the disease began almost at the same time with one pupil in each dormitory. Here the crowding was such that the beds touched one another, and propagation took place from bed to bed with the greatest regularity. Of the first two cases one came from a city infected with typhoid, and the other from Bucharest, where the epidemic among the population had preceded that in the army. The author considers that these observations suggest prophylactic rules which should be observed in schools and barracks, and in general in all places where people are crowded together. Knowing that the danger of contagion is greater in dormitories, it is important to put the beds as far apart as possible; to isolate immediately every suspected case; to avoid all immediate contact, and to carry out the disinfection of the bed-clothes and the room in which the first case has developed.

RAW OYSTERS AS A CAUSE OF INFECTION. Du Camp, Sabatier, and Petit² discuss the relation of the ingestion of oysters to the etiology of typhoid fever. They recognize the fact that some epidemics have apparently owed their origin to oysters, but their researches carried on at the Zoological Station at Cette, have shown:

¹ Spitalul, Bucuresti, 1898, xviii. 7.

² La presse méd., 1898, vi. t. i. 240.

"1. That oysters from the beds of Cotte contain neither the bacillus coli nor the typhoid bacillus, but common species frequently found in the water.

"2. That oysters placed for a month at the opening of a drain contain neither the colon bacillus nor the typhoid bacillus, but only bacteria of green fluorescence.

"3. That oysters inoculated directly either with the bacillus coli communis or with Eberth's bacillus, in liquid or solid cultures, and left in the beds, contain at the end of a few days neither the colon bacillus nor the typhoid bacillus. These organisms disappear either because the salt water forms an unfavorable medium for their growth or because the oysters exercise with regard to them some manner of vital defence."

They believe that infection through the ingestion of oysters should not hold the place which it now occupies as one of the demonstrated etiological conditions in typhoid fever.

Carrazzi¹ also concludes that the idea that typhoid fever may be conveyed by means of raw oysters is entirely without foundation. This observation, however, provokes an answer from Bordini-Ffreduzzi,² in which he quotes the observations of Klein, Foote, Cann, Broadbent, Pasquier, Chantemesse, and Levis, all of which tend to show that typhoid organisms may not only gain entrance into the oyster, but remain living for some weeks. He insists that the danger from eating raw oysters is by no means over-estimated.

In connection with this subject it may not be out of place to refer to the fact that the most clearly proven epidemic of typhoid due to raw oysters in this country, that occurring at Wesleyan University, Hartford, Connecticut,³ was due to oysters infected not in their own habitat, but as the result of being placed in contaminated fresh water that they might swell and assume a more appetizing appearance.

INFECTION THROUGH SALADS. The interesting suggestion is made, in *La Riforma Medica*,⁴ that plants used as salad may serve to convey the infectious agents. This is especially possible in view of the fact that different species of herbs used as salad are often raised in manure, for which human feces are sometimes used. Lettuce is washed by gardeners in any sort of dirty water. And yet a more important manner in which such herbs may become infected is in the process of bleaching, for which manure is often used. If contaminated in this manner it is easy to see that it would be almost absolutely impossible to remove infectious agents by washing alone. Laveran⁵ has published several cases of typhoid fever

¹ Giorn. di agricolt. mod., 1898, No. 25.

² Riforma Medica, 1898, xiv, t. iii, 383.

³ New York Medical Record, 1894, xlv, 743.

⁴ 1898, xiv, t. ii, 287.

⁵ The reviewer has been unable to find the original article.

occurring in a body of troops, among officers who lived in barracks, while those living outside were unaffected. The water used in the barracks was of excellent quality and beyond suspicion. Typhoid bacilli, as well as eggs of tania, were found in the herbs used for salad.

CONTAMINATED WATER-SUPPLY. That an infected water-supply is a very common cause of epidemics of typhoid fever needs no further proof, but two epidemics recently studied by Pfeiffer¹ are such interesting examples of explosive outbreaks of the disease definitely traceable to this source, that they are well worth quoting briefly :

The first, occurring in 1895 in Lueneburg, was restricted almost entirely to families supplied by a particular water company. This company furnished unfiltered water from the river flowing through the city. For ten days, owing to changes in the water-works, the supply was drawn from a point in the middle of the city only 200 metres below the outlet of one of the main sewers, and less than 100 metres below a house where there was a case of typhoid fever whose excreta were being thrown, unsterilized, into the river. This criminal act of the water company was followed, as might have been expected, by an explosive epidemic. The second epidemic, which was due to an infected well, is even more interesting. Here it was demonstrated that out of about three hundred people exposed to the infection, nearly one-third contracted the disease.

Romine and Closson² also report an interesting epidemic of typhoid fever where, out of 225 men, 61 were seized with the disease and 12 died. All those taken sick had been drinking water out of a well which was shown chemically to contain an undue proportion of both free and albuminoid ammonia. No case existed outside of those drinking the suspicious well water.

Such an epidemic as the first of those reported by Pfeiffer ought to strike home to those of us who live, as most of us do in this country, in cities where the water-supply is unfiltered and taken from sources in many ways open to contamination. In almost all of our large cities hundreds of valuable lives are sacrificed yearly because of our neglect to provide proper methods of filtration for our water-supply. It is a sad commentary on our nineteenth century "civilization" that when this danger is realized and when the means of escaping it are perfectly within our power, our hands are often tied by the dishonesty—and this is a mild word—of our city officials and legislators.

TYPHOID FEVER DUE TO A PARA-COLON BACILLUS.³ Gwyn reports a case of great interest which the reviewer had the good fortune to

¹ Klin. Jahrbuch, 1898, xvii. 159.

² Philadelphia Medical Journal, 1898, ii. 1030.

³ Bulletin Johns Hopkins Hospital, 1898, ix. 54.

observe. This was clinically a typical instance of typhoid fever with rose spots, palpable spleen, diarrhoea, abdominal pain, and later, intestinal hemorrhage. The patient finally recovered. There was a diazo reaction in the urine. Blood cultures taken at the height of the attack revealed a small, actively motile bacillus, suggesting the *B. typhosus*. "It decolorized fairly well by Gram, grew on agar as a gray-blue, moist, raised film, clouded bouillon, giving no scum on the surface and no precipitate. Milk was only faintly acidified, resuming its original tint in the course of ten or twelve days. Potato showed a brown-yellow, moist layer of growth. There was no liquefaction of gelatin; slight stab and surface growth. Plates of gelatin and of gelatin diluted with bouillon gave some circumscribed blue-gray colonies, about $\frac{1}{4}$ mm. in diameter; the microscope showed light-brown, regularly outlined, granular colonies, with no nucleus. The fermentation reactions showed fermentation of glucose, slight in saccharose, levulose, and mannite, but none in lactose. Sugar-free bouillon in tubes, to which 3 per cent. of various sugars was added, was used. There was no production of indol. By van Ermen-gen's flagellar stain, from two to four flagella could be made out. No peritrichal arrangement as in the bacillus typhosus was seen.

"The serum reactions were as follows: The patient's serum at different dates during his illness gave a rapid, complete agglutination in low dilutions, and showed reaction in dilutions up to 1 to 150 to 1 to 200, the highest being at date of discharge. On December 18th, two months after date of culture, there still remains a slight reaction.

"The same serum was without action on the bacillus typhosus in any dilution above 1 to 1 or 1 to 5.

"Two varieties of colon were agglutinated by the patient's serum as high as 1 to 50 and 1 to 60, but two normal sera agglutinated the same organisms in dilutions running from 1 to 60 to 1 to 100.

"Typhoid sera of agglutinative strength, ranging from 1 to 300 to 1 to 1100, were without effect on the bacillus in dilutions over 1 to 1 and 1 to 5. One typhoid serum, strength 1 to 900, with bacillus typhosus, gave an incomplete reaction as high as 1 to 30. Several of these sera had little or no effect even in dilution 1 to 1. One normal serum affected the bacillus rapidly at 1 to 1, failing at 1 to 5. A typhoid bacillus was affected similarly; a colon was agglutinated as high as 1 to 220; another normal serum had little or no effect at 1 to 1, while rapidly and completely agglutinating the colon organisms."

The cultural properties of this bacillus were almost precisely similar to those of Widal's¹ para-colon bacillus, an organism which he considers to stand, as it were, half-way between the typhoid organism and the

¹ Semaine méd., August, 1897.

colon group. The only difference was in the fermentation of saccharose. As Gwyn remarks, however, the fermentation of saccharose is a variable characteristic in the colon family and may not occur with every member, so that this slight difference in fermentative quality may, perhaps, be a feature of the para-colon family as well.

The serum of this patient never gave Widal's reaction with typhoid cultures, not even a month after his discharge from the hospital.

Though Gwyn speaks with much caution of the conclusions which are to be drawn as to the nature of the case, it would appear to the reviewer that there is every probability that the symptoms—clinically those of typhoid fever—were due to infection with this organism; and the symptoms justify us in assuming that intestinal lesions with ulceration existed.

Out of 265 cases of typhoid fever Gwyn found the serum reaction in every case excepting here and in two doubtful infections.

If this be true, the fact that an organism failing to react to typhoid serum and showing cultural differences, even though slight, from the *B. typhosus* may produce clinically and, inferentially, anatomically, typical typhoid fever is a discovery of no small importance. It would be a matter of great interest to know whether others of the occasional instances of absence of Widal reaction may not be due to similar conditions.

LARYNGEAL MANIFESTATIONS. Schulz¹ has succeeded in demonstrating the specificity of the typhoid lesions in the larynx. In small swollen lymph nodules on the laryngeal surface of the epiglottis, in a fatal case of typhoid, he found, in the connective tissue between the infiltrated areas and the cartilage, staphylococci and short, rather plump, rodlets. The infiltration of the lymph follicles in the larynx was at the same stage as that in the intestine. Several of these lymph nodules were excised after being washed in distilled water, cut in two, and put in bouillon in the thermostat. From the bouillon they were transferred to agar-agar. From others smear preparations were made from the surface of the section onto agar. Both staphylococcus aureus and albus were obtained, and also a thin moist layer which proved to consist of motile rodlets. On some agar tubes only this whitish-gray layer was found. The rodlets grew well in bouillon, making it cloudy throughout; they gave no reaction for indol. They neither curdled nor soured milk, nor did they ferment grape-sugar bouillon. Fresh bouillon cultures, when treated with the serum of a patient with typhoid fever diluted fifty times, gave a typical Widal reaction.

Symptoms and Types. Griffith² treats of typhoid fever in infancy

¹ Berl. klin. Wochenschrift, 1898, xxxv, 748.

² Philadelphia Medical Journal, 1898, ii, 783.

and childhood. A number of cases have recently been reported tending to show that the disease is not, after all, very uncommon during the first two years of life. Griffith reports the case of a child, aged three months, who died of typhoid fever. During life it had suffered for six weeks from frequent vomiting and a troublesome, dry cough. The physical signs were indefinite. For a week the temperature was not above 100° ; after this it became elevated, the bowels looser, curdy, and green. There was a hacking cough. Death occurred eight days later. Three further cases are reported: one, fatal, at seven months; one at fourteen months, and one at nineteen months. According to Griffith, the symptoms are, as a rule, indefinite and uncharacteristic in onset; milder, and with a tendency to a shorter course and a disposition for the nervous symptoms to overbalance the intestinal manifestations. The disease begins more suddenly than in adults, so that "in the course of only a few days the attack is in full swing, and even the characteristic spots may be present." More commonly, though, the attack is slight and insidious. Children walk about with loss of appetite, perhaps headache and slight malaise. The physician only gradually comes to realize that he is dealing with typhoid fever. The temperature tends to vary from its more typical course in adults; it may rise suddenly, and often runs a very irregular course, especially in infants. During the fastigium the temperature often remains high, with but little variation between the morning and evening elevations. The remittent type which is so frequent toward the end of typhoid in adults is often absent or greatly curtailed, the temperature falling perhaps by crisis. Abortive types are common, lasting sometimes not more than a week; the average duration is certainly shorter than in adults; roughly speaking, this may be estimated at from fourteen to twenty days. The nervous symptoms overbalance the intestinal manifestations, and yet even they are insignificant in the majority of cases. Headache is common, but is often slight, and many children remain in the best of spirits throughout the attack. Often there is slight delirium, and in some instances screaming. Apathy is an important symptom, but subsultus and coma vigil are rare; nervous disturbances, suggesting meningitis, may occur, especially stiffness of the neck and a tendency towards opisthotonos. Herpes may occasionally be seen. Griffith believes that the eruption is as frequent as in adults. Enlargement of the spleen is always present. The tongue is less often dry than it is in adults. Vomiting is a frequent initial symptom, and is commoner later in the attack than with adults. The condition of the bowels varies, and appears to bear no relation to the severity of the disease. Diarrhoea was, in Griffith's cases, a symptom of little importance. Hemorrhage is rare and generally slight—a fact due, he believes,

to the moderate development of the intestinal lesions. Perforation is also infrequent, but may occur, Schofield having reported a possible case in a baby of twenty-one months.

NERVOUS MANIFESTATIONS Guizzetti¹ found severe changes in the sympathetic nervous system in ten cases of typhoid fever, the lesions being especially marked where fatal complications, such as peritonitis, hemorrhage, or broncho-pneumonia, were absent. He, therefore, believes that these changes may have tended to cause the fatal exit. In two cases which died of heart-failure he found a neuritis segmentaria in the cardiac plexuses and small-celled infiltration in the intracardiac ganglia. In twenty-two patients dying from other diseases no such severe changes were to be found in the sympathetic nervous system.

Monteux and Lop,² during an epidemic of typhoid fever in Marseilles, observed two cases in which the symptoms suggested some affection of the pneumogastric nerve. There was dyspnoea coming on in paroxysms, tachycardia, hiccoughs, tympany in the region of the stomach, pain in this organ, spontaneous and on pressure, and also in the region of the pneumogastrics in the neck, and the pupils were unequal. There were no lesions in the heart or in the lungs capable of producing these phenomena; the urine was free from albumin. Several observers have described such symptoms, especially Peter. The authors believe that symptoms relative to the pneumogastric nerve should be recognized among the other nervous troubles occurring in typhoid fever.

PERFORATION OF THE APPENDIX. Rolleston³ reports a case of perforation of the appendix in walking typhoid. The accident occurred twelve hours after the patient entered St. George's Hospital, and operation was without avail. In fourteen out of sixty cases of typhoid fever observed at St. George's Hospital, changes were found in the appendix. In five there was tumefaction; in seven ulceration; in two perforation. Perforation occurred in eighteen of these sixty cases (11 per cent. of all perforations). This is the same percentage found by Naeke. Finney estimates it at about 5 per cent., and Fitz at about 8 per cent.

HEMIPLEGIA AND APHASIA. Rolleston⁴ also reports an instance of left hemiplegia, with aphasia, coming on in a man, aged thirty years, on the twenty-fourth day of the disease. There were no convulsions at the onset. The patient gradually recovered. Hawkins has collected seventeen cases of this nature, and believes that they are due to embolism and thrombosis. The absence of convulsions is contrary to the idea of thrombosis, and suggests that the lesion was probably in the middle cerebral

¹ Arch. per le sci. med., 1898, xxii. 65.

² La presse médicale, 1898, Ann. vi. t. i. 254.

³ Lancet, 1898, i. 1401.

⁴ British Medical Journal, 1898, i. 1201.

artery. There was no sign of syphilis. Herringham records the case of a girl of nine years, with paralysis in the third week. Two years later weakness of the limbs on the right side and in other parts still existed. Thromboses in small veins are, of course, not unusual in typhoid. Hawkins says that eight cases similar to those of Rolleston are reported in English literature, although others have been observed on the continent, and lately Osler has reported one. Recovery is the rule. Only two autopsies have been made, in each of which there was found thrombosis of the middle cerebral artery. In Duncan's case the heart was dilated, but otherwise healthy.

Rolleston comments on the difficulty in distinguishing clinically between thrombosis of cerebral veins and cerebral arteries.

An interesting note by Osler upon this subject will be found in the *Journal of Nervous and Mental Disease* for May, 1886, while the reviewer has reported two instances in the *Johns Hopkins Hospital Bulletin* for April, 1896.

LOW TEMPERATURE. Rosenthal¹ reports a case of typhoid in which, on the fourteenth day, the temperature fell to 95° F., remaining subnormal for four days, and afterward pursuing a fairly characteristic course. There was no evidence of hemorrhage.

RELAPSES. Hunt² observed relapses in twenty-eight out of seventy-one cases—a proportion of 40 per cent., which is exceptionally high. In two cases there was a double relapse and in one three. No cause for these relapses could be found. The mortality in these seventy-one cases was 7 per cent. There were fifteen instances of intercurrent relapse, and eleven occurring after the apyretic period, which varied between one and nineteen days, the average being eight days. The course of the fever in all cases resembled that of the ordinary attack. Only three of the twenty-eight relapses died, and in eight the duration did not exceed a fortnight. In no instance was the onset sudden, nor was the characteristic temperature-curve of Irvine observed. Symptoms differed from those of the primary attack only in being milder and appearing at an earlier date, the temperature reaching its maximum sooner and the rose-spots appearing from the third to the seventh day. The shortening and mollifying of the relapse, the author believes, is due to the partial immunity conveyed by the first attack. The relapses were more common in cases with diarrhoea.

TYPHOID FEVER WITHOUT INTESTINAL LESIONS. Several very interesting communications have been made within the past year on the subject of typhoid fever without intestinal lesions. Nichols and Keenan³ have collected nine instances of sufficiently well-identified cases of this

¹ Philadelphia Medical Journal, 1898, i. 120.

² Practitioner, 1898, lx. 263.

³ Montreal Medical Journal, 1898, xxvii. 9.

nature. They call attention to the fact "that the time has gone by when we could regard typhoid as an infective process localized in the intestines, producing the general symptoms by the secondary action of its toxin; rather, have recent researches proved that the disease is an infective one, invading the organism through the lymphatics of the intestine and infecting the system as a whole, the intensity of the lesions being generally, but not invariably, directly proportional to their proximity to the point of inoculation; the brunt of the disease hence may fall upon lymphoid tissue, parenchymatous organs, or, at times, the central nervous system." The intestinal tract, then, merely represents a point of departure of the typhoid bacillus, not the sole place of localization for its development. They report the case of a laborer, twenty-five years of age, who was admitted on June 28th to the out-patient department, stating that for about two months he had been suffering from severe headache, loss of appetite, and general weakness. He had been obliged to give up work several times. He was somnolent and mentally dull. There was high fever; the tongue was coated; the abdomen distended, tense, and tender, showing faded rose-spots; the spleen was palpable; the pulse was dicrotic; the bowels were constipated. The urine was free from albumin; the blood, examined by Wyatt-Johnston, gave the serum reaction. For five days the patient was semi-comatose, after which low, muttering delirium and vomiting came on. After the first week there were involuntary evacuations; fever continued with some variations up to the time of death, which occurred on the 21st.

On autopsy there was splenic tumor; enlarged, soft, congested mesenteric glands, especially in the ileocecal region. "while the lowest three Peyer's patches of the ileum were slightly raised above the general surface, but showed no signs of inflammation." No focal necroses were recognizable in the liver. Both lungs showed areas of broncho-pneumonia at the bases. Microscopically, great numbers of *M. lancolatus* were found about the areas of broncho-pneumonia. The spleen, which was hyperplastic and congested, showed infarctions; it contained clumps of *B. typhi* in the pulp. In the mesenteric glands typhoid bacilli were also found in characteristic clumps. Sections were made through one of Peyer's patches which presented the slight swelling. All that could be found was a proliferation of the lymphatic tissue in the submucosa which was very generally infiltrated with lymphoid elements. The patch was not congested, and there was no evidence of necrosis. After staining by Löffler's method, in the deeper parts were found small clumps of bacilli resembling typhoid which decolorized by Gram's method. In the superficial part were numerous bacilli of various kinds, evidently intestinal bacteria, which stained by the Gram-Weigert method.

Cultures made from the blood at autopsy were negative, the serum giving the typical Widal reaction. Cultures from the spleen and liver revealed typical typhoid bacilli; these were obtained from the spleen.

They conclude that atypical typhoid may be "a very protean disease, its toxic power at one time being concentrated upon the mesenteric glands, at another upon the spleen, the liver and gall-bladder, the central nervous system, upon the kidneys, heart, or lungs, as the case may be." They bring up the question as to whether in some atypical cases the typhoid organism may not enter in some other manner than through the intestinal canal, possibly, for instance, through the lungs. In their own case, however, they are inclined to believe from the enlargement of the mesenteric glands that the point of origin was intestinal; the local intestinal lesions may have been more marked earlier in the course.

An extremely interesting instance of the same nature is reported by Flexner and Harris.¹ After summarizing the cases in the literature, and particularly emphasizing the remarkable contribution of Chiari and Kraus, who found seven out of nineteen cases between January and May, 1897, in which the anatomical lesions of the disease were wanting, the serum reaction having been positive, they relate the following case, which the reviewer had the opportunity of observing clinically: A man, sixty-eight years of age, was admitted to the hospital on October 28th, complaining of shortness of breath. He had been losing weight and strength for two months. During this time he had felt ill, though he was unaware that he had had any fever. Two weeks before entry, severe pain in the abdomen; shortness of breath. Two days before entry he fell to the floor while undressing, and had been in bed since that time. There was high fever; respirations 44 to the minute; loud friction rub in the right axilla. The spleen was not palpable; there was a leucocytosis of 18,000. No great change in the patient's condition was noted on the following day. He died at 10 o'clock on the 30th. The autopsy, made on the day after death, showed thrombosis of the main branch of the pulmonary artery supplying the lower lobe of the right lung, gangrene of the lung, perforation of the pleura, pyopneumothorax. There was acute splenic tumor. The œsophagus, stomach, and intestine, excepting the appendix vermiformis, which was converted into a fibrous cord, were not remarkable. *The mesenteric glands showed nothing abnormal.*

Plate cultures upon agar-agar made from the right lung (gangrenous portion), left lung, liver, kidneys, and spleen showed pure cultures of the *B. typhosus*. An agar-agar plate from the heart's blood and a blood-serum tube from the cerebro-spinal fluid remained sterile.

¹ Johns Hopkins Hospital Bulletin, 1897, viii. 259.

These organisms gave a characteristic Widal reaction with serum from a case of typhoid fever.

The authors believe that "the tests employed for the identification of the organisms isolated from the several viscera leave no doubt as to their nature, and the case, therefore, is properly to be regarded as one of typhoid infection without intestinal lesions or glandular enlargement; indeed, it would have been impossible to diagnose the case as typhoid fever in the absence of bacteriological examination."

These two cases are of great interest. In the former the manifestations were clinically those of typhoid fever, and, as the authors themselves acknowledge, it may be that the intestinal lesions were previously more marked than at the time of the autopsy. In the latter the absence of any intestinal lesions whatever, as well as of enlargement of the mesenteric glands, together with the entire failure of any symptoms during life which suggested the disease, make the observations of very unusual interest. Did infection in these cases take place through the gastrointestinal tract? In the first this seems probable, but in the second one need well raise the question whether infection may not have entered through some other channel.

INTESTINAL SYMPTOMS. Osler¹ calls attention to the fact that the severity of the symptoms of typhoid fever bears no relation to the extent or intensity of the intestinal lesions, and protests against the growing tendency to treat the disease as if it were localized in the small intestine. He summarizes the intestinal symptoms in ninety-nine cases, occurring in his wards during the year 1897. The absence of intestinal manifestations in this particular series of cases is doubtless rather unusual, but nevertheless the analysis "will show how slight the enteric symptoms may be." He distinguishes (*a*) symptoms of onset; (*b*) symptoms during the course; (*c*) symptoms during convalescence.

In the first class pain in the bowels was complained of in twenty-three cases, and was rarely severe. In one instance attacks of pain in the right flank suggested a possible appendicitis. This has been observed before, a number of cases being on record in which the appendix has been removed on account of this suspicion.

In forty cases there was looseness of the bowels or active diarrhoea; in twelve purgative medicine had been taken, but in other instances this may have been and probably was the case.

Of the symptoms during the course of the disease, pain occurred in eleven instances; one patient had persistent pain during the first week; one for a single day only, the twenty-seventh. In two cases the pain was so severe as to cause some uneasiness, in one having been possibly due to a

¹ Philadelphia Medical Journal, 1898, i. 30.

cholecystitis. Of the ninety-nine cases only twelve had diarrhoea while in the hospital, and "in not a single instance was it severe or protracted enough to require treatment." In three of these twelve cases it was just after admission; in two it was only for a single day. "This, of course, is an exceptional experience, and illustrates how variable typhoid fever may be."

Slight distention of the abdomen was present in eight cases. In no instance was it severe or the cause of any uneasiness. "It (meteorism) is rarely present with constipation, and is usually an accompaniment of diarrhoea. When extreme there is no intestinal symptom, with the exception of perforation, of graver omen or more difficult to combat." This observation is one which physicians who are in the habit of treating their cases by the Woodbridge method, or by other methods which interfere unnecessarily with the action of the bowels, would do well to bear in mind. Any one with a large clinical experience with typhoid fever cannot fail, the reviewer believes, to recognize its truth.

Hemorrhage occurred in five instances. All recovered. It is interesting that out of these ninety-nine cases there was no instance of perforation. Of the intestinal features in convalescence constipation was the only annoying one met with. Osler notes that diarrhoea, though rare, is a distressing symptom in convalescence, and is usually due to persistence of ulceration in the large intestine. It may prove very intractable.

Among these ninety-nine cases not a death occurred from intestinal complications. There were but four fatal cases: one, a colored woman, died the day after laparotomy was performed for acute cholecystitis and peritonitis; one died of asthenia in the fourth week of the disease, the day after admission; one, the old man already referred to in the note of Flexner and Harris, died of pneumonia with pulmonary gangrene and general typhoid infection without intestinal lesions; and one died with a "most profound involvement of the nervous system."

Sequelæ and Complications. GLOSSITIS. M'Crae¹ reports a case of glossitis occurring at the beginning of a relapse. The tongue was much swollen, protruding between the teeth. There was marked salivation. The condition cleared up in the course of six days. Cultures from the tongue were negative. Considerable relief followed hemorrhage after the taking of the culture; this suggests the value of incisions into the substance of the tongue in the treatment of such cases.

CHOLECYSTITIS AND CHOLELITHIASIS. Cushing² reports a case of typhoid cholecystitis in a woman, aged twenty-six years, who had

¹ Johns Hopkins Hospital Bulletin, 1898, ix, 118.

² Ibid., ix, 91.

never, so far as could be made out, suffered from any febrile disease beyond pneumonia ten years before. For three years she had had occasional attacks of vomiting after indiscretions in diet. She entered the hospital complaining of pain in the region of the gall-bladder of five days' duration. There was moderate fever. The gall-bladder was palpable and on operation was found to contain a small amount of brownish mucoid material and fifteen gallstones. Cover-slip preparations showed rod-shaped organisms with rounded ends. The organisms, both morphologically and on culture, presented the characteristics of the *B. typhosus*. The serum reactions were also positive. "The patient's blood serum produces a distinct and rapid agglutinative reaction of the original organism and of the control, both obtained from agar slants four days old. The blood serum from a case of typhoid fever in the medical wards produces a similar reaction with both organisms. Blood serum obtained from a healthy adult produces no clumping or loss of motility in either case."

Acute cholecystitis as a complication of typhoid has been recognized by many observers, and the extreme frequency with which typhoid bacilli are found in the gall-bladder in artificial infections in animals as well as in human beings is well known. Flexner has found the organism in the gall-bladder in 50 per cent. of his cases at autopsy. That the local inflammation is often due to this infection has also been clearly shown. Welch, in 1890, called attention to the presence of micro-organisms in the centre of gallstones, and suggested that they might be the starting-point for the deposition of the biliary salts. Since this time observation has tended to show that in reality cholelithiasis is in most instances due to infection. Gilbert and Fournier,¹ as a result of their experimental researches, have divided biliary lithiasis into two great pathological groups: lithiasis due to the colon bacillus—by far the most common—and lithiasis due to typhoid. Indeed, conditions similar to cholelithiasis have actually been reproduced in guinea-pigs and rabbits. What are the steps in the process? Observation and experiment justify one in assuming with Cushing that: "(1) The bacilli during the course of typhoidal infection" (or, under other circumstances, the *B. coli communis*) "quite constantly invade the gall-bladder; (2) the organisms retain their vitality in this habitat for a long period; (3) in the course of time the bacilli are almost invariably found to be clumped in the bile, suggesting the occurrence of an intravesical agglutinative reaction; (4) these clumps presumably represent nuclei for the deposit of biliary salts, as micro-organisms may with regularity be demonstrated in the centres of recently formed stones; (5) gall-

¹ Compt.-Rend. Soc. de Biol., 1897, 936.

stones being present in connection with the latent, long-lived infective agents, an inflammatory action of varying intensity may be provoked at any subsequent period."

Cushing has collected six cases of post-typhoid cholecystitis associated with gallstones where, on operation, the *B. typhosus* has been isolated, as well as five similar cases occurring in the Johns Hopkins Hospital in which only the *B. coli communis* has been found.

The most interesting feature of Cushing's own case is that there was absolutely no history of clinical typhoid fever—a fact rendering the case unique.

Miller¹ reports the case of a woman, aged thirty-seven years, who had two attacks of biliary colic seven years before, followed a month after by what was termed a "bilious fever," lasting about four weeks, and succeeded four or five weeks later by a relapse of a month's duration. Ever since this time she had had frequent attacks of biliary colic. There was tenderness over the gall-bladder; no tumor to be felt. On operation there were extensive adhesions about the gall-bladder. Gallstones were found in the bladder and cystic duct, as had been suspected by Dr. Ramsay, as well as a small amount of bile and a milky fluid. A bacteriological examination of the fluid showed a pure culture of the *B. typhosus*. Gwyn found that the organism gave a typical Widal reaction. "An agar smear from the patient, L. P., agglutinated typically by serum of a typhoid patient. Serum of patient L. P. agglutinates a known typhoid organism rapidly at 1:100 dilution. Reaction is immediate and positive, more like that of an acute attack than of an attack several years ago."

This is a most important observation. Knowing what we do of the etiology of gallstones, the question naturally arises, Was the general typhoid infection secondary to a local infection of the gall-bladder, or was the infection of the gall-bladder, perhaps originally with colon bacilli, a secondary infection with typhoid following? That the former is not an unreasonable supposition is testified to by the previous case of Cushing, where a local infection of the gall-bladder was present without history of a previous general infection.

The work of recent years has shown us that the *B. typhosus*, like the *M. maceolatus*, may give rise to various local affections as well as to general septicæmia. Most of these local affections probably follow a primary, more or less characteristic typhoid fever. We know, however, that a general typhoid septicæmia may exist without intestinal lesions, and it is by no means improbable that local typhoid infections in other parts may exist primarily. These may, perhaps, in some instances give rise subsequently to more general invasions.

¹ Johns Hopkins Hospital Bulletin, 1898, ix, 95.

HÆMATURIA. Guinon¹ reports the case of a boy, aged ten years, who had a simple purpura at the time of the onset of typhoid fever. The development of the symptoms of typhoid was marked by hæmaturia, which lasted four days. The disease was of a severe type. The roseola was marked, and fresh purpuric spots kept appearing. There was a large amount of albumin in the urine. Finally, on the twenty-first day, there appeared a general morbiliform exanthem, which may have been due to a secondary infection or to large doses of quinine (1.5 in four hours). The case ended in complete recovery without persistent albuminuria.

ATROPHY OF THE OPTIC NERVE. Panas² reports a case of atrophy of the optic nerve following typhoid fever; this originated, apparently, in an optic neuritis. The condition was unilateral and due, the author believes, to foci of cerebral inflammation. The reviewer has observed a similar instance.

NEURITIS. Poix and Gaillard³ report a case of neuritis of the brachial plexus. A man, aged twenty-two years, with mild typhoid fever, suffered from pain in his right upper extremity, which was followed by paresis with consecutive atrophy of the rhomboids, serrati, deltoids, supraspinatus and infraspinatus muscles. The supraspinous and infraspinous fossæ on the right side became excavated, and the patient could not raise his arm above the horizontal position. The condition was one of typical angel-wing scapula. There were no fibrillary twitchings. There was diminution in the tactile, thermic, and pain-sense in the supraspinous and infraspinous fossæ; no vasomotor or trophic troubles. There was reaction of degeneration in the atrophied muscles. All the muscles affected belonged to the group innervated by the collateral branches of the brachial plexus.

The authors know of no other instance where a neuritis of this localization has followed typhoid fever.

MALARIAL FEVER. Combined infections of typhoid fever and malaria have been discussed in the article on malaria.

Diagnosis. THE WIDAL REACTION. Although the Widal reaction is now in general use in diagnosis, its significance is quite obscure. Widal considered it as merely a reaction on the part of the body to the infection. Courmont ascribes it to the arousing of the defensive forces of the animal organism, and gives it great weight in prognosis. Chantemesse believed that the appearance of the specific reaction indicated the formation of antitoxin. Grüber saw in the strength of the reaction a correspondingly firm establishment of immunity.⁴ The theories of

¹ *Riforma Medica*, 1898, Ann. xiv. t. ii. 33.

² *Rev. internat. de méd. et de chir.*, 1898, ix. 181.

³ *La presse médicale*, 1898, Ann. vi. t. i. 215.

Widal and Courmont are at present given most preference; of the substance or substances producing the reaction but little more is known; its presence in the serum rather than in the cellular elements of the blood, and in most, if not all, of the fluids of the body, has been demonstrated; a close connection with fibrin, the albumin, and the globulin has been repeatedly shown. Numerous experiments have made it clear that the blood is the tissue which possesses, as a rule, the maximum agglutinative power.

With the general adoption of serum diagnosis various modifications in the original procedures have been introduced. Johnston,¹ of Montreal, has shown that dried preparations give accurate and reliable reactions.

Although precise measurements of the serum's power may be made, ordinary requirements call for only an approximation thereto. Dried blood is in almost general use in board of health laboratories. In hospital service, however, the obtaining of serum presents no difficulties and is the more serviceable method. It is now generally agreed that the usual time for a reaction to appear is between the fifth and tenth days of the disease. Cases reacting earlier than the fifth day are not often met with. In these early reactions the common uncertainty as to the time of onset of typhoid must be considered. Delayed appearance of the reaction is quite common. Bensaude, Achard, Stern, Kolle, Durham, and Grüber instance reactions first seen as late as from the fourteenth to the thirty-fifth days of the disease. Thoinot reports a case negative until its second relapse. Cases reacting as late as the twenty-second, twenty-sixth, thirty-fifth, and forty-second days are given by Gwyn in the Johns Hopkins cases. Unfortunately, several well-authenticated cases are now on record as never having given the specific reaction.² Among these are instances in which the diagnosis has been substantiated by the cultivation of the *bacillus typhosus* from the spleen and circulation. The reaction may appear suddenly within twenty-four hours, or may completely vanish in the same time. Variations in the agglutinative power in the same case from time to time are not unusual.

The persistence of the power is most uncertain. Remaining, as a rule, well marked for three or four months after the illness, it may disappear early in convalescence.³ Positive reactions have been found after eight and twelve years.

During the febrile state the agglutinative power tends gradually to

¹ New York Medical Journal, October 31, 1896.

² Widal et Sicard. Soc. méd. d. hôp., December 11, 1895. Artaud et Barjon. Presse méd., 1898. Gwyn, l. c.

³ Bensaude. Thèse Paris. July, 1897, No. 631.

rise, falling subsequently in convalescence. In a majority of cases the serum may be diluted two hundred to three hundred times, and yet react well. Reactions in dilution of 12 : 15,000 are instanced by Widal and by Biberstein.¹ On the other hand, some cases may never give positive results if diluted more than ten to twenty times. The power may bear no direct relation to the severity of the infection.

Many observers believe with Widal that the reaction is merely one of infection. Others, especially Courmont, as mentioned previously, illustrate their theory of the defensive significance with appropriate cases in which the temperature falls with the rise of the agglutinative power, instancing also examples of the absence of the reaction until late in the course of severe infections, and its occasional disappearance before death. The evidence supports Widal. Pfeiffer has shown that the solvent property of the serum of immunized animals upon typhoid bacilli, a property which has been proven to be closely connected with the immunizing substance, is distinct from the agglutinating power. The former may be present in high degree while the latter is absent.²

Most statistics show figures apparently more or less influenced by the opinions of the authors. In some reports completely positive results have been recorded in all cases. In the majority, however, a small percentage of non-reacting cases show that the test is not absolutely without defects.

Widal, in 177 cases, gives one case (proved bacteriologically) without reaction. Courmont³ reports 257 cases, among which three very doubtful infections failed to react; Bensande,⁴ eighty-five, all positive; Biberstein,⁵ 101 cases, with one negative result; Kerr,⁶ 169 cases, of which number four doubtful cases failed to show the reaction.

Gwyn, in 265 Johns Hopkins cases, found one typical typhoid, and two doubtful infections which failed to react. Thompson,⁷ in 800 collected cases, mentions six as giving negative results, leaving a positive percentage of 99.2. Cabot,⁸ from 300 collected cases, calculates that in over 95 per cent. the reaction was present at some time in the disease. There are innumerable reports of smaller collections of cases, many of which are, unfortunately, open to criticism, owing to the incompleteness of their observation.

¹ *Zeitschrift f. Hygiene*, 1898, xxvii. 3.

² Pfeiffer and Kolle. *Centralblatt f. Bakt.*, 1896, xx. Nos. 4 and 5. Pfeiffer and Marx. *Deutsche med. Woch.*, 1898, xxiv. 489. Ehrlich and Morgenroth. *Berl. klin. Woch.*, 1899, No. 1.

³ *Thèse Lyon*, July, 1897, No. 122; *Presse médicale*, January 5, 1898.

⁴ *Thèse Paris*, July, 1897, No. 631.

⁵ *Zeitschrift f. Hygiene*, 1898, xxvii. 347.

⁶ *Scottish Medical and Surgical Journal*, 1898, ii. 5, 70.

⁷ *Medical Record*, 1897, lii. 826.

⁸ *Clinical Examination of the Blood*, 1898.

With regard to the specific nature of the reaction it may be said that but few of the instances in which positive results with sera of diseases other than typhoid have been obtained can be considered. Normal serum will in many cases give quite decided reactions even when diluted five to ten times, especially if allowed to act for one or two hours. The non-observance of this fact has clearly been responsible for numerous doubtful results. We require now that serum in such low dilution as 1:10 or 1:20 shall have agglutinated the organisms firmly within half an hour.

Out of 3000 cases not typhoid not more than a dozen have given positive reactions with proper technique, and even these might be excluded (Cabot).

Apparently reliable agglutination of the bacillus typhosus has, however, been obtained by Jez in a case of tubercular meningitis, by Van Ordt in one of ulcerative endocarditis, by Block in a case each of malaria and diabetes, and by Stern in several normal individuals.

After the expectations aroused by Widal's announcement, the results of serum diagnosis have been somewhat disappointing: though present in an immense majority of cases, the appearance of the reaction is often too late to be of diagnostic service. Reliable instances of its absence in typical typhoid infections and of its occasional presence in other affections have, unfortunately, caused much skepticism among the general medical profession. Rarely more than 50 per cent. of cases are found to give a reaction when first seen or admitted to hospital wards. Many feel that its appearance thus after the establishment of the disease gives it value more as a confirmatory than as a diagnostic test. It must, however, be admitted that a sign present in over 95 per cent. of cases demands more consideration than any of the uncertain indications previously relied upon, and it may finally be said that the presence of a Widal reaction positive under all requirements is an absolute indication of a typhoid infection, although, unfortunately, such an infection is not excluded by the reaction's absence.

TYPHOID FEVER IN CHILDHOOD. Griffith, in his article previously referred to, believes that many cases of so-called simple continued fever in children are typhoid. Meningitis must be carefully excluded. Influenza may cause some trouble in diagnosis. Typhoid fever cannot be excluded in young children or infants (or anywhere else, W. S. T.) because we fail to find roseola or enlargement of the spleen. The Widal reaction is reliable proof. The occurrence of other cases in a household will, of course, help in the diagnosis.

Treatment. **DIET.** Bushuyev¹ (Bushuyeff) makes an interesting

¹ *Vruch*, 1898, xix, 786, 898.

appeal for the more liberal feeding of patients with typhoid fever. Inasmuch as his communication is in Russian and inaccessible to most, it may be well to give here a careful summary of his results.

The author enters at length into the literature concerning the diet in typhoid. He notes the fact that most of those who object to liberal feeding base their objection, not so much on the insufficiency of the digestive juices as on the danger of the production of hemorrhage or perforation; but the changes resulting in perforation rarely appear suddenly; they come on gradually. They are so distant from the stomach that by the time substances, even though hard to digest, reach these areas, they are so far changed that one can hardly imagine that they could actually injure the intestine. Wholly indigestible substances, such as fruit-seeds or skins, might injure the gut, but even they are, as a rule, so far rolled up in mucus or intestinal contents as to be harmless. In autopsies on cases of typhoid on the thirtieth day or later, in patients who had been liberally fed, the intestine was in the same condition as under ordinary typhoid diet. One never hears of perforation of a tuberculous ulcer due to food. The cause of perforation is the nature of the ulcer and not the character of the food. Bushuyev knows of nothing to support the view held by some that injury to the intestinal walls by solid food might provoke a re-entrance of the bacilli and an increased frequency of relapses. (On the other hand, we know that the organism is present in very small numbers, or, indeed, absent from the intestinal tract. W. S. T.)

In the year 1895-1896 the author arranged with his colleague, Dr. Sartsievich, a skeptic with regard to the advisability of liberal feeding, to divide all patients who entered the hospital into two series, one of which should come under Bushuyev's care, one under that of Dr. Sartsievich. The patients of Dr. Sartsievich received only milk, as much as two litres in the twenty-four hours, and one or two eggs, soft-boiled or in Stokes's mixture. On the other hand, Bushuyev's patients were allowed, usually, 715 grammes of white bread, 170-180 grammes of boiled meat, a cutlet, and soup. If possible, there was given in addition a small quantity of supplementary milk and egg. The patients of both departments were allowed tea, wine (32 to 64 c.c.), and water. The following table shows the result:

	Bushuyev.	Sartsievich.
Whole number of patients	80	74
Recovered:	72 (90 per cent.)	65 (87.8 per cent.)
Average day of illness on entrance into hospital	7.5	5.8
Average day on entrance to division	8.1	8.3
Day on which recovery was complete	49.5	55
Number of days spent in hospital	42	49.2
Days of fever in hospital	48.9	22.3

	Bushuyev.	Sarts evich.
Dismissed incapable of duty	6 (8.3 per cent.)	10 (15.1 per cent.)
<i>Died</i> :	8 (10 per cent.)	9 (12.1 per cent.)
Average day of entrance to hospital	8.5	5.8
Average day of entrance to division	9.1	8.1
Day of death (average)	28.6	26.7
Number of days between entry and death	20.1	19.4

The figures, though small, speak decidedly in favor of liberal feeding, especially inasmuch as the cases coming under Bushuyev's care entered the hospital at a later period of their illness.

The author especially emphasizes the fact that, though his patients received a relatively liberal diet, yet the conditions of a military hospital rendered it impossible to give them anything like a proper regimen. (And this, be it noted, in a Russian military hospital in time of peace! Our own commissary department may not form so remarkable an exception.—Reviewer.)

From the table of supplies open to him the author has devised the following plan for feeding typhoid patients, which he has carried out for two years :

7 A.M. Tea with a roll.

8 A.M. 400 c.c. of soft (liquid) oatmeal, barley, or wheat porridge, with butter.

9 A.M. One or two boiled eggs, soft or hard, as the patient desires.

10 to 11 A.M. A glass (200 to 220 c.c.) of milk with a roll, one-half a cutlet, and a bit of boiled meat (160 to 168 grammes).

12 to 12.30 P.M. A plate (220 c.c.) of chicken-soup or a bowl of ordinary soup, sometimes with a bit of chicken from the soup, and a small cup of *kisel* (a sort of sour jelly); rarely, a little preserved fruit.

3 P.M. Tea with a roll.

6 P.M. A cup of chicken or beef-soup; semolina pudding or milk; a bit of chicken.

8 P.M. Milk with a roll.

During the night. Coffee or tea, with milk, two to four times; coffee with cognac.

For dinner and supper the white bread may be replaced by black (with the crust), and the soup by a thick wheat gruel. Many patients prefer the boiled meat to cutlets, and the ordinary soldiers' soup to hospital soup and gruel. The milk is generally boiled; occasionally it is given in the form of junket. As beverages, the patients were allowed cold water, boiled or unboiled, cranberry juice, milk of almonds, small amounts of beer, kvass. The cranberry juice was particularly grateful to the patients. In addition, all patients receive one to three ounces of wine in the morning, and every two hours 16 c.c. of Stokes's mixture.

Patients when quietly sleeping were not awakened either for food or medicine.

The author believes that had he had a greater variety of articles of food he could have excited the appetites of the patients, so that in some instances they might have eaten more. As it was, some complained of an insufficiency of bread. He was also unable to give the patients as much milk as he wished.

As a result of his experience, he says, "Not allowing myself to jump at rash conclusions, I will restrict myself to this alone, that the outcome and course of typhoid fever with a hospital diet as general as possible is not in the least worse than with a restricted diet."

During the year 1897, under this diet, he lost 26 out of 318 patients, or 8.2 per cent.

During the ten years, 1888 to 1897, the deaths from typhoid fever at the military hospital at Kiev varied between 10 and 19.3 per cent.; the mean for the ten years was 12.4 per cent.—358 deaths in 2887 patients. Thus in 1897, with a mixed diet, the death-rate was materially less than for the ten years previously.

Under this regimen the general condition of patients is incomparably better than when kept upon an exclusively fluid diet. The common complaints are scarcely ever heard. At breakfast, dinner, and supper the patients are uncommonly wide awake; even those who are very ill sit up in bed, beg for food, and eat with much satisfaction; only a few have to be fed by nurses. If one observe the patients at meal-times he wholly forgets that these individuals are seriously ill, with temperatures above 39° C. The military authorities are amazed on visiting a typhoid ward at the time of breakfast or dinner, "inasmuch as they see almost no typhoids." The observation of the late Prof. M. T. Chudnovsky, that the typhoid state disappears under a full diet, is confirmed. This condition was seen chiefly in patients transferred from other wards where they had been on an exclusively liquid diet. During the first hours in the ward the patient lies in a motionless condition, failing to answer questions and refusing food. But if one succeed in some way or other in persuading him to eat a bit of meat, or cutlet, or an egg, he immediately begins to show some interest in the surroundings. In a few days, often within a day, no trace of the typhoid condition remains. Unfortunately, it is impossible to persuade all typhoid patients to eat, at least what is at one's disposal in a military hospital. Attempts at forced feeding cause vomiting. Every care should be directed toward stimulating the patient's appetite and to avoid disgusting him by what is brought before him.

It is a different matter when the patient enters in an unconscious condition; then a liquid diet should be given—as much as he can take without vomiting. If it be impossible to feed him by the mouth, then he should be fed through the nose with a tube.

"*Appetite*, when it may be excited, lasts usually to the end of the illness ; its diminution or disappearance is a grave sign."

The tongue and lips of the patients remained in a relatively good condition. There were no unpleasant *gastric* or *intestinal* symptoms. The bowels were often constipated ; pea-soup evacuations were met with only in cases fed mainly on milk and bouillon.

"*Intestinal hemorrhage* in feeding with a solid diet is not in the least more frequent than on an exclusively liquid diet. In the parallel investigation with Dr. Sarsievich there was not a single case of intestinal hemorrhage among my patients. In 1897, among 318 patients, there were four instances of hemorrhage—that is, 1.7 per cent.; while according to Homolle, it occurs in 4.65 per cent.; according to Barth, in 2 per cent.; according to Griesinger, in 5.3 per cent.; according to Murchison, in 3.77 per cent.; according to Liebermeister, in 7.3 per cent.; according to Stecher, in 10 per cent. Of my four patients with hemorrhage, two died ; the other two recovered, notwithstanding the fact that in one of them the hemorrhage was abundant and protracted. It is interesting that of these four patients only one received a solid diet ; two entered in so serious a condition that they had to be subjected to forced feeding—*i. e.*, only a liquid diet ; finally one, a military physician, was fed throughout the course of his febrile stage, which lasted six weeks, only upon bouillon, milk, coffee, and tea with milk, because he feared solid food. Thus the figures also show that the critics' fear of hemorrhage from solid diet is not supported.

"*Perforation* in the last two years has occurred only once in 509 patients—that is, in 0.19 per cent.—while other authors estimate it at from 1.25 to 3.04 per cent.

"*General peritonitis* (non-perforative) was met with twice. One patient was admitted with a beginning peritonitis, but in the other it arose in the hospital. As in the case of perforation, so the peritonitis in the second case arose at a time when the patient was already being forcibly fed—*i. e.*, on liquid nourishment.

"*Otitis media* and *parotitis* were rare, and no bed-sores occurred."

The loss of weight was less than in patients fed on a more restricted diet. The general condition was so good that the patients preferred, as a rule, to walk to their tubs and to the closet. "Long before the end of the fever they get out of bed, and there is much difficulty in making them lie down. In summer they go out into the garden almost upon the first day of the afebrile condition. All that has been said relates not only to soldiers, but also to officers. With the latter, by the way, it is always necessary to enter into considerable explanation to overcome the fear of a solid diet and the early period at which they are allowed to leave the bed. It is to be hoped that this fear may disappear quickly

also among physicians, and that they may all in the end learn the simple truth, that for the patient as for the healthy man that diet is best which pleases him most. It is not necessary to go to any trouble that the food may contain a certain quantity of albumin, of fat, and of carbohydrates, but that it shall be tastefully prepared and may excite the appetite. Every effort of the physician who has under his care severely ill patients should be directed toward the stimulating of the latter by the, so to speak, natural means, namely, food. In the absence of appetite one cannot hope for much success, even from forced feeding. But if one succeed in exciting the patient's desire for food the privileges and advantages of a mixed, liberal diet become quickly evident. Whoever once attempts to feed his typhoid patients will never repent it, and will not meet with as many severe forms of typhoid as are observed under a restricted diet; for instance, the so-called hemorrhagic forms seen by Dr. Sartsievich in two patients."

While one cannot but feel that this is the article of an enthusiast, yet both the reasoning and the figures are such as to make us reflect. Is it not more than likely that many cases of typhoid fever suffer from too restricted a diet? Bearing in mind the long course of fever through which the patient must pass, the dangers to which he is exposed not only from exhaustion and the accidents peculiar to typhoid fever, but especially from the various secondary infections to which he is so easy a prey at the end of his long period of fever and fasting, our main object should be to keep up his general nourishment by every means in our power. Obviously, if a more liberal diet than that afforded by the purely liquid regimen could be assimilated, the patient's strength would hold out materially better. In diphtheria or pneumonia or febrile tuberculosis do we not make every effort to induce the invalid to take as much as he can bear of a simple, easily absorbable, and nourishing diet? And yet in typhoid fever we are restrained by a vague fear that any departure from the customary regimen is, for some reason or other, dangerous. What ground have we for this fear? The ordinary answer is the quotation of a case where, after a long course of fever, with a much restricted diet, some indiscretion has produced a sudden rise of temperature with alarming symptoms. An indiscretion in diet may produce such symptoms in any condition of severe physical exhaustion, but the reviewer has never seen anything to suggest that this is more common in typhoid fever than in any other similar condition.

And those observers who in recent years have intelligently adapted the diet to the patient have only good reports to make. Such observations as those of Shattuck¹ and Bushuyev are the best proofs that there

¹ *Journal of the American Medical Association*, 1897, xxix. 51.

is no special condition in typhoid fever which contraindicates rationally liberal feeding.

Bearing in mind the frequency of intestinal lesions we should, of course, avoid substances which leave an undue residue, but that the general course of the case would improve, that convalescence would be quicker, that lives would actually be saved, if, as Shattuck says, we paid more attention to our treatment of the patient than to that of the disease as such, the writer is convinced.

The amount and nature of the nourishment given to each case must, of course, depend largely upon individual circumstances—the mental condition of the patient, the appetite, the character of the dejecta, the abdominal manifestations. Every care must, of course, be taken not to disgust the patient, and to avoid the development of unpleasant gastric or intestinal symptoms, for, as has already been said, our main object should be to keep up the strength; but in most instances there is probably no reason why the diet in typhoid should differ essentially from that in any similar infection. One cannot do better than to quote from the excellent article of Dr. Shattuck :

“ I would not be understood as advocating an indiscriminate diet. My plea is simply for treating the patient rather than the disease ; for feeding him with reference to his digestive power rather than solely or mainly with reference to his fever ; for the view that the danger of accidents from the local intestinal ulceration is not increased by allowing him to partake of articles which leave no irritating residue, and which cautious trial shows are digested without disturbance or discomfort. At one end of the scale are the cases with such irritability or weakness of the stomach as to lead to the unfortunate term gastric fever, or those with pronounced diarrhœa and undigested food in the stools ; at the other end are those more numerous cases with clean tongue and a desire for food. Between the two is every gradation. The life of the former may depend on the skill and ingenuity of the doctor, assisted by the intelligent devotion of the nurse. The comfort and the duration of disability of all others may be materially modified for good by careful study and wise individualization of our cases. A long list of permissible articles from which selection can be made for different cases, and for the same case at different times under varying circumstances, can be given. That which I append makes no claim to completeness, but is meant merely to be suggestive and illustrative :

“ TYPHOID DIET. 1. Milk, hot or cold, with or without salt, diluted with lime-water, soda-water, Apollinaris, Vichy ; peptogenic and peptonized milk ; cream and water (*i. e.*, less albumin), milk with white of egg, slip buttermilk, koumyss, matzoon, milk whey, milk with tea, coffee, cocoa.

"2. Soups: beef, veal, chicken, tomato, potato, oyster, mutton, pea, bean, squash; carefully strained and thickened with rice (powdered), arrowroot, flour, milk or cream, egg, barley.

"3. Horlick's food, Mellin's food, malted milk, carneptone, bovine, somatose.

"4. Beef-juice.

"5. Gruels: strained cornmeal, crackers, flour, barley-water, toast-water, albumin-water with lemon-juice.

"6. Ice-cream.

"7. Eggs, soft-boiled or raw, eggnog.

"8. Finely minced lean meat, scraped beef. The soft part of raw oysters. Soft crackers with milk or broth. Soft puddings without raisins. Soft toast without crust. Blanc mange, wine jelly, apple-sauce, and macaroni."

THE COLD-BATH TREATMENT. Much has been written during the last year concerning the advantages and disadvantages of the cold-bath treatment. Eichberg¹ protests against its use. He asserts that the advocates of the Brand treatment are entitled to the thanks of the profession for proving:

1. That constant supervision and nursing are of greater importance to the patient than medication.

2. That the temperature furnishes the most important guide in the symptomatic treatment, and that it must be taken regularly day and night during the entire course of the disease, in order that the indications of treatment be promptly met. He believes that this is all that can be said for the Brand treatment, which he considers cruel, barbarous, and dangerous.

Eichberg treats his patients by rest in bed, ice-cap to the head, a diet of milk and albumin-water, small quantities of dilute hydrochloric acid, or 2 grains of quinine in chlorine-water three times a day; 4 grains of acetanilid and a tablespoonful of whiskey are given whenever the temperature reaches 103° in the mouth or 102.5° in the axilla. This dose usually suffices to control the temperature for six hours. "In some cases it has been found to be a powerful depressant, and a dose of 2 grains suffices. In other cases where the effect was inconsiderable the dose has been increased, though never exceeding 6 grains at a single dose." The patient is not allowed solid food until his temperature has been normal for a week. The bowels are moved by simple enemata, but when more than two movements a day occur Hope's camphor mixture is used. The ice-cap is not removed from the head until the temperature has been normal for twenty-four hours.

¹ Philadelphia Medical Journal, 1898, ii. 297.

Insomnia is treated by 25 grains of chloralamide. His tables are based upon a hospital experience of six years, and his figures, he says, are somewhat more favorable than those from other departments of the hospital. The cases, however, unfortunately numbered only 136. There were 6.6 per cent. of deaths; the percentage of relapses was 7.3; of hemorrhage, 2.9 per cent. During the past five years the mortality in other services than his own has been 12.1 per cent.

Griffith,¹ in children, uses purely symptomatic treatment: rest in bed; milk diet if possible; no purgatives; enemata. Careful judgment is to be employed in giving baths to children. Some do not bear the plunge at all well. This is particularly true of younger children. "Certainly there is, as a rule, no period in childhood when one should use water at as low a temperature as in the case of adults. At the Children's Hospital in Philadelphia it is our custom to employ the graduated bath, placing the children into the tub with water at a temperature of 95°, and cooling it down to 85°, or occasionally, with older children, to less than this. In nearly all cases this is quite as efficacious as the cold bath, and much less likely to cause fright." Very frequently sponging answers every purpose. A tepid bath sometimes suffices. Children bear fever well. "We can, therefore, often afford to let the fever alone. If it is true of adults, it is still truer of children, that hydrotherapy is not to be used as an unalterable treatment, no matter what its effect, and merely because the temperature has reached a certain degree. If it is used according to any such method it is capable, particularly in children, of doing far more harm than good."

Wilson² publishes statistics of eight years' treatment of typhoid fever by cold bathing in the German Hospital. In the entire eight years there were 741 cases, with 55 deaths, 7.42 per cent., a percentage very close to that obtained by Osler in the Johns Hopkins Hospital. Wilson modifies the Brand treatment somewhat, giving, at the onset, calomel, sometimes in fractional doses, but more frequently in doses of 0.3 to 0.05, followed, if necessary, in the course of several hours by a mild saline. These purgatives may be repeated once or twice in cases which come in sufficiently early, but are never administered in patients entering after the tenth day.

Cold compresses, or ice-bags, are applied to the abdomen in all cases of tenderness or spontaneous pain and in hemorrhage. When tympanites is marked, turpentine stupes are applied, at intervals, in connection with the external use of cold.

The cold-bath treatment is abandoned, as a rule, only on signs of peritonitis, hemorrhage, or perforation. The other treatment is symp-

¹ Loc. cit.

² Philadelphia Medical Journal, 1898, ii. 79.

tomatic. With defervescence dilute hydrochloric acid is given for a short time, and later, if there be persistent anemia, some form of iron.

The baths are ordered every three hours if the axillary temperature is 101.4°. As every now and then a patient asked for the bath when the temperature was below the regular limit, Wilson adopted the rule of giving one or two plunges a day during the defervescence, and a plunge every day or every second day for a short time after defervescence has been completed.

Wilson believes that the success of this method is determined by the period at which it is instituted in any given case—the earlier the better.

“When the patients are able to, they are allowed to walk to their baths.” This practice, he believes, has some advantages. “Our experience leads us to believe, however, that the development of somnolence, gastro-intestinal catarrh, and the intestinal paresis to which tympanites is due, is favored by the log-like, continued passive recumbency of the patient suffering from enteric fever. The muscular atrophy due to disuse and the diminished activity of the lymph through the body cannot be disregarded in this connection. The vast majority of patients suffering from enteric fever are adolescent and young individuals at the most active period of life. The disease develops with comparative rapidity, and is of long course. Have we not in the enforced continued repose been adding to the pathological process a secondary disturbance of nutrition due to disuse of function? Our experience in the last year justifies me in answering this question in the affirmative.”

Theoretically, it would appear to the reviewer that thorough and well-carried-out massage, such as should be given during the baths, ought to accomplish these results as well, and with less danger to the patient, than by allowing him to take exercise which, in many instances, cannot but be fatiguing. The value of properly carried out massage in all diseases in which it is necessary to keep the patient for a long period in bed is, we believe, not sufficiently recognized; even if recognized, such treatment is not often enough put into practice.

F. E. Hare¹ is a most enthusiastic supporter of the cold-bath treatment. It cannot be denied that his results have been good, and he has had exceptional advantages in carrying out his treatment. With a very large clinical material, his patients have been placed in special wards. The diet in ordinary cases consisted of milk and beef-tea—three pints of the former and one of the latter, as a rule, a day. Ice-water is allowed *ab libitum*. Alcohol is given symptomatically when indicated. He has devised an ingenious and excellent stretcher, upon which the patient is lifted from his bed directly into the bath, thus avoiding undue

¹ The Cold Bath Treatment of Typhoid Fever.

violence. On admission, if the patient has not reached the ninth day of the disease, some unirritating purgative, usually castor oil, is given. Calomel was given in some cases, but the author believes that it has its disadvantages, occasionally failing to act, and not infrequently causing unexpected irritation.

The baths are ordinarily given at a temperature between 75° and 80° —*i. e.*, at the temperature at which the water flows from the main. They are repeated every three hours when the temperature is 102.2° F. or above. The duration of the first bath is ten minutes; a half-hour after its termination the temperature of the patient is again taken by the rectum. If this has not fallen to 101° or lower, various modifications in the temperature and duration of the baths are introduced.

"Care is always taken that the patient is not unnecessarily disturbed. To this end food, stimulants, medicines, etc., are given at intervals of three hours, or some multiple of this time, except in the cases to be afterward considered, where the baths are given more frequently." Frictions could not be given, as a rule, owing to insufficiency of service. The author is particularly impressed with the good influence of cold baths on the respiratory complications. Statistics, he believes, show the fear of inducing pneumonia to be baseless. *"That the danger does not exist is proved by the fact that pneumonia is precisely one of the complications that is rendered infrequent by systematic bathing."* The good influence of bathing upon the nervous and psychical symptoms was also marked. The relative infrequency of the accumulation of sordes on the lips and teeth was due, the author believes, to the stimulation afforded by the baths to the salivary secretion. The tendency toward diarrhea, statistics also show, has been diminished. Hare discusses at length the dangers of perforation and hemorrhage. In 586 carefully studied cases before the bathing period 2.9 per cent. died from perforation and 1.88 per cent. from hemorrhage. Out of 1902 cases treated during the ten years by bathing, 2.9 per cent. died of perforation and 1.2 per cent. of hemorrhage. In discussing perforation he notes particularly the infrequency of the onset in connection with bodily exertion. He considers carefully the influence of the treatment upon the duration of the disease and upon the occurrence of relapses. The bath treatment appears to have shortened the average stay of the patients in the hospital about 4.8 days. With regard to relapses, the author is unable to draw any positive conclusions.

The influence of the treatment upon the mortality and prognosis has apparently been very striking: 1828 consecutive cases occurred between May 15, 1882, and December 31, 1886. These cases were under expectant treatment—cold sponging and the occasional use of other refrigerative measures short of the cold bath. The death-rate was 14.8 per cent.

Out of 1902 cases treated during the following ten years by the bath treatment, the mortality was 7.5 per cent. The following tables show his results :

TABLE I.—“EXPECTANT PERIOD.”

Year.	No. of Cases.	Deaths.	Percentage Mortality.
1882 (from May 15)	147	25	17.0
1883	273	40	14.6
1884	575	89	15.5
1885	369	49	13.3
1886	464	68	14.6
Totals	1828	271	Average 14.8 per cent.

TABLE II.—“BATH PERIOD.”

Year.	No. of Cases.	Deaths.	Percentage Mortality.
1887	239	27	11.3
1888	339	23	6.8
1889	595	42	7.0
1890	160	16	10.0
1891	137	7	5.1
1892	104	7	6.7
1893	50	2	4.0
1894	79	1	1.3
1895	69	8	11.6
1896	130	10	7.7
Totals	1902	143	Average 7.5 per cent.

He considers the various possibilities of error, showing conclusively that a change in the type of the disease is not to be thought of. The systematically carried out bath treatment shows its main effect, apparently, in reducing the number of deaths from thoracic complications or from exhaustion as such.

He discusses in an interesting manner the effects of delayed admission, reaching the conclusion that : “(1) Admission was practically without influence in increasing the danger of death from perforation or hemorrhage. (2) The whole difference in mortality in favor of cases admitted early was due to the lessened mortality from causes mainly pyrexial in nature.”

The mortality was appreciably greater among the men than among the women—8.7 to 5.6 per cent. The author believes that the prognosis is 50 per cent. better under the cold-bath treatment than under expectancy.

The baths are regulated according to the temperature of the patient. “The following definite rule of practice was finally adopted : The first bath is of a temperature of as near 70° F. as possible, and lasts ten minutes. In the event of an insufficient fall in the temperature, each succeeding bath is prolonged by five minutes until the desired result is attained. When the bath has reached a duration of thirty to forty

minutes, and still fails to reduce the temperature sufficiently, then the temperature of the bath is reduced by 5° F. at a time by the addition of cold water down to 60° F. or even 57°. There are cases, however, in which even this will not suffice, and in them I have again gradually prolonged the duration of the bath to sixty minutes. . . . In cases which presented unusual resistance to refrigeration the baths were steadily decreased in temperature and prolonged in duration until, as in the case cited, the patient remained for one hour in water below 60° F." Alcohol administered before the bath was found to increase its effect. "In a few isolated cases of obstinate pyrexia, in which from nervousness or from some other idiosyncrasy of the patient it is not possible to push refrigerative measures to the extent mentioned, . . . I have been in the habit of administering in addition antifebrin. . . . It should never be given in doses exceeding 5 grains for an adult, and its use should be limited strictly to cases just described; it should be regarded, in fact, as a *pis-aller*. Furthermore, its use should be limited in these cases to the period, usually but a few days, during which the temperature is obstinate, being discontinued immediately the temperature becomes manageable by the bath. Finally, it should not be given more than three times in the twenty-four hours; once is frequently enough." The fever in the early stages of the disease is more resistant to the baths; these, therefore, are continued longer. In old patients with weak hearts "vigorous antipyresis is . . . contraindicated, as a rule; while tepid baths of apparently short duration are found to be both efficient and grateful to the patient." Neither diarrhea nor meteorism calls for a cessation of bathing. Small quantities of the blood in the stools do not of necessity contraindicate bathing, but the baths are always stopped if the hemorrhage has been sufficient to affect the temperature. If the temperature rises after the hemorrhage, and there is no reappearance within three days, the baths are resumed. Unusually high temperature during this period is combated by antifebrin.

On the other hand, H. A. Hare and Holder,¹ from a comparison of large numbers of statistics from different sources, arrive at much less favorable conclusions with regard to the value of the bath treatment. They believe that the effect of improved sanitation has been to decrease the virulence of the infection. They protest vigorously against Wilson's method of allowing the milder cases to walk to their tubs, and deprecate the use of baths in patients who are feeble. They emphasize Liebermeister's suspicion that the cold bath may increase the tendency to hemorrhage, but acknowledge that this does not appear to be proved by statistics. They believe that statistics prove the greater frequency of

¹ Therapeutic Gazette, 1898, xxii. 153.

relapses with the cold-bath treatment. They assert that "the influence of the bath treatment on the duration of the disease seems to be to prolong it," though their statistics are not conclusive. They conclude that, taking everything into consideration, the cold bath is responsible for the saving, at most, of but 2.5 per cent. Protesting against the almost universal use of the bath, they urge its more judicious and symptomatic application and its modification to suit individual circumstances. "When we consider all the points in the cold-bath treatment, it is almost impossible to avoid the thought that it is a measure to which in a few years we will look back with the same distress with which we now regard venesection and other excesses."

Out of 356 cases in Osler's wards only 299 were bathed, "showing that in Osler's view a fairly large proportion of cases are not suited to the bath." "No bath in typhoid is properly given if active rubbing of the body is not resorted to while the patient is in the bath." If there be constipation or moderate diarrhoea at the onset of the disease, they advise the administration of a "full dose of calomel in divided doses." Cold sponging is sufficient in most cases. "It is advisable not only to use friction in a light form, but to use moderately active massage, with the same objects in view as when the rest-cure is undertaken, for the proper treatment of typhoid is modified rest-cure. We are firmly convinced that by this means bed-sores, local congestions and effusions, cedematous swellings, peripheral nerve-pains, and muscular feebleness will be largely decreased; and Pospischn has shown that mechanical irritation of the skin is capable of increasing heat loss 95 per cent." H. A. Hare particularly advises the administration of "more nourishment than the average typhoid patient has usually had in the past. . . . Almost any article easy of digestion should be allowed, as one or two or more lightly boiled eggs, cornstarch, arrowroot, etc. Stimulants should be used in carefully graduated doses whenever the circulation needs them, particularly alcohol. . . . Let the physician be a watchman constantly, and a therapist or hydrotherapist only as necessity arises."

While the statistics of the past year only go to uphold the generally accepted view that the cold-bath treatment of typhoid fever is the best method which we yet possess, there is wisdom in the protestations of Hare and Holder against the injudicious use of this measure. The reviewer has had opportunity of following the cases treated in the Johns Hopkins Hospital almost from the beginning of the application of this method; and, both from his observations there and from the accumulating statistics, is convinced of its value and of the wisdom of its application in most cases. Possibly, however, harm has been done by too specific and dogmatic directions as to just when and how it should be

used. The author doubts the necessity or wisdom of ever giving baths below 70° F., and is convinced, on the other hand, of the advisability in many instances of raising the temperature of the water considerably. With a nervous or intelligent patient the first bath should almost always be given at 80° or even as high as 90°, the temperature being gradually reduced. In many instances baths at 80° may answer well throughout the course of the disease. Undue excitement of the patient should be avoided in every possible way. Modifications in the length of the baths or in their frequency must, of course, be made symptomatically, and such modifications are often advisable. As stated above, the reviewer heartily concurs with the observations of H. A. Hare upon the value of judiciously applied massage, not only during but after the bath period.

It ought not to be necessary to remind individuals who are fitted to practise medicine that no rule can be laid down for the treatment of any disease which is not open to many exceptions. The appreciation of the conditions calling for such exceptions must depend upon the judgment of the physician. If the practice of medicine could be regulated by rules, the function of the physician would be small.

ANTITOXIC TREATMENT. Walger¹ reports upon several cases of typhoid fever treated with specific human serum according to the method of Weisbecker. Four cases, all of which were apparently of extremely serious nature, were thus treated. All recovered more or less rapidly after the initiation of treatment, which occurred on the eighteenth day. The injection appeared to be followed by an appreciable change for the better in the patients' condition, the temperature reaching normal for a part of the day, at least by the second or third day, practical apyrexia being reached by the seventh day in the first case and the fifth day in the second. In the latter two cases the improvement in the general condition was marked. This was especially shown by the great improvement in the appetite. The author enters into some speculation as to what the effect of the injections may be upon the anatomical course of the disease, and mentions the fact that in all four cases the diazo reaction persisted some time after the injection, while in three instances a typical typhoid roseola developed. In the two latter cases a relapse occurred, during which, on account of its mild character, the serum was not used.

Chantemesse² has apparently succeeded in obtaining a "toxin" of high virulence, to which horses are especially sensitive. He has obtained this substance in comparatively pure form, and studied its effects upon animals. He has succeeded, after two years' careful work, in immunizing a horse, and has obtained a serum which has high antitoxic and

¹ *Centralbl. f. inn. Med.*, 1898, xix. 941.

² *La presse médicale*, 1898, Ann. vi. t. i. 180.

preventive properties in animals. "Armed by these experiences, I have been able to inject antitoxic serum in men suffering from typhoid fever. The value of this new method of treatment cannot be judged other than by the study of statistics and by numerous observations. In the meantime I may say that the serum acts well in men suffering from typhoid fever, acting after the manner of an antitoxin, diminishing and suppressing the nervous phenomena, lowering the temperature, hastening recovery."

LAPAROTOMY FOR INTESTINAL PERFORATION. Cushing¹ reports three cases of operation for intestinal perforation. One of these instances was fatal; in another recovery followed; in the third operation no perforation was found, and recovery followed. The first case is of especial interest in that three operations were performed, the second and third being demanded by the existence of intestinal obstruction. The author discusses the importance of leucocytosis as an evidence of perforation, and, while acknowledging that its presence points strongly toward the existence of some inflammatory complication, recognizes the fact that after perforation with a general septic peritonitis the leucocytosis may in great part or completely disappear. The conclusions, with which the reviewer most heartily concurs, are as follows:

"When the diagnosis is made operation is indicated, whatever the condition of the patient. As Abbé's case exemplifies, no case may be too late. A precocious exploration from an error in diagnosis is not followed by untoward consequences, such as must invariably be expected after a neglected and tardy one."

Our present knowledge amply corroborates the statement of Mikulicz made at Magdeburg in 1884: "If suspicious of a perforation one should not wait for an exact diagnosis and for peritonitis to reach a pronounced degree, but, on the contrary, one should immediately proceed to an exploratory operation, which in any case is free from danger."

Prophylaxis. Pfeiffer and Marx² make a most interesting communication upon preventive inoculations against cholera and typhoid fever with preserved virus. Pfeiffer and Kolle published a method of immunizing men against typhoid fever, based upon the same principle which Haffkine has made use of in his anticholera injections, consisting of the subcutaneous inoculation of 2 milligrammes of an eighteen-hour agar culture of typhoid organisms. This is followed by a transient rise of temperature to about 38.5°, accompanied by moderate subjective symptoms of headache and loss of appetite. In ten days the blood shows a solvent power upon typhoid organisms—in other words, the characteristics of the serum of individuals who have recovered from

¹ Johns Hopkins Hospital Bulletin, 1898, ix. 257.

² Deutsche med. Wochenschrift, 1898, xxiv. 489.

typhoid infection. They found by experiment on animals that by the addition of 0.5 per cent. carbolic acid, after sterilizing the dose for inoculation, the substance might be kept for at least a month and a half without suffering any diminution in its activity. They then proceeded to experiment with human beings, using of a virus preserved for two months and a half a quantity equal to that given by Pfeiffer and Kolle. They gave in quantity 0.2 of their mixture, which corresponded approximately to the 0.002 of typhoid culture used by Pfeiffer and Kolle. After several hours the patients complained of headache and weakness, and the temperature rose to about 38° . One patient felt well on the following day; the two others complained of headache and had a temperature of 38° on the following day as well. About the point of injection there was a slight swelling and reddening as large as the palm of the hand. By the end of the second day all the patients felt well. The results were as good as those obtained by Pfeiffer and Kolle with fresh inoculations. None of these individuals had ever had typhoid before, and in none did the blood possess before treatment an agglutinating or solvent power. Even after the inoculations the agglutinating power was absent in one and relatively slight in the others. The solvent action, however, upon the typhoid bacilli in the peritoneum of guinea-pigs was extremely marked in all instances. It is particularly interesting that the serum which was most active in the animal body was the one which gave no agglutinative reaction outside.

The agglutinating and solvent powers of immune serum are, as has been pointed out before, quite different. The solvent power, as has been shown in the most interesting manner in another connection,¹ is that indicating the presence of the anti-body. The significance of the agglutinating power is as yet unknown.

The practical importance of these observations of Pfeiffer cannot be over-estimated. There is good reason to believe that this method is capable of giving a really satisfactory immunity, the duration of which is, however, uncertain. The method is simple and apparently safe, and it is not unreasonable to hope that by its application the dangers to physicians, nurses, and attendants in typhoid fever and cholera epidemics will be greatly lessened. Further confirmation of the value of the method and observations as to the duration of the immunity acquired are necessary before arriving at conclusions concerning the advisability of its use in conditions other than during actual epidemics.

Wassermann² has made some interesting experiments which go to support Ehrlich's "Seitenkettentheorie" of immunity. According to Ehrlich, many toxins on injection into the animal body enter into

¹ Ehrlich and Morgenroth. Berl. klin. Wochenschrift, 1899, xxxvi.

² Berl. klin. Wochenschrift, 1898, xxxv. 209.

intimate chemical union with the protoplasm of certain body-cells. The protoplasm of these cells possesses special groups of atoms (*Seitenketten*), which normally have a chemical affinity for substances which serve to keep up the nutrition of the cell. This same affinity may, however, exist between these atom groups and certain poisons, so that on entrance of such a poison into the circulation a chemical union rapidly occurs. Such a union would deprive the cell of its normal nutritive functions, and in the absence of some regenerative power the affected elements would of necessity perish. This regenerative power, however, exists and results, according to Weigert's¹ law of overcompensation, in an overproduction of similar groups of atoms. The excess eventually break loose from their point of origin and circulate in the blood. These groups of atoms are now capable of immediately uniting with and binding any fresh toxin which may enter into the animal organism. Thus the poison is neutralized before it is capable of uniting with the fixed body-elements. Such free groups of atoms, then, represent the antitoxin. Every antitoxin has a physiological analogue, and the process of antitoxin formation is but the exaggeration of a physiological process of regeneration.

Proofs of the accuracy of this theory have been rapidly accumulating. An admirable summary of the subject may be found in the article on "Toxin und Toxide," in Eulenburg's *Real-Encyclopædie der gesammten Heilkunde*, by Morgenroth.

This chemical union between toxins and elements of the fixed tissues of the body does not occur everywhere, but is restricted in different diseases to especial tissues. Thus Wassermann² has demonstrated in a most interesting manner that in tetanus the union occurs especially with elements of the brain and cord; indeed, an emulsion of brain and cord if stirred up outside of the body with tetano-toxin results in a chemical union which destroys the toxicity of the mixture.

Brieger, Kitasato, and Wassermann³ have shown that artificial immunity may be acquired by inoculations of animals with typhoid organisms.

Pfeiffer, Kolle,⁴ and Marx⁵ have since demonstrated that, as a result of subcutaneous inoculation of dead or living typhoid bacilli, a substance appears in the blood-serum of animals and human beings which has a destructive and solvent property upon typhoid bacilli, and the presence of this substance in the blood of animals results in immunity against infections with the *B. typhosus*.

Wassermann and Takaki have now shown that a few days after inoc-

¹ Verhandl. der Gesellschaft deutscher Naturforscher u. Aerzte, 1896.

² Berl. klin. Wochenschrift, 1898, xxxv. 4.

³ Zeitschr. f. Hyg. u. Infectiouskrankh., xii. 139.

⁴ Centralbl. f. Bakt. 1896, xx. Nos. 4 and 5.

⁵ Loc. cit.

ulation with typhoid bacilli, before these immunizing bodies are present in the blood, their presence in large quantity may be demonstrated in the bone-marrow, the spleen, and the lymphatic tissues of the body. This would appear to be convincing evidence that there is a special relation between the toxic substance in typhoid fever and these tissues, and that the anti-bodies which convey immunity against typhoid infection arise from these special organs.

The possible practical significance of these discoveries is easy to see; indeed, Behring has already announced that Wernicke in his laboratory has succeeded in immunizing susceptible animals against anthrax by the means of substances derived from the spleen.

The nature of these anti-bodies, which convey immunity in typhoid fever and similar conditions and produce the solvent action upon typhoid bacilli, has recently been discussed in a most interesting and convincing manner by Ehrlich and Morgenroth.¹

DIPHThERIA.

Etiology and Manner of Infection. Fritz Franz² notes that the Klebs-Loeffler bacillus may vary greatly in its characteristics; those held to distinguish the pseudo-diphtheria bacillus all lie within the region of variations which the true diphtheria bacillus can show. There are wide-spread saprophytes which can be distinguished from the true diphtheria bacillus only by pathogenicity.

The question arises, Is pathogenicity sufficient? C. Fränkel says that virulence is too variable a quality to be used as a dividing line. The virulence of the diphtheria bacillus can be varied according to the kind of medium used. It can be completely destroyed. Experiments by Trumpp, working in Escherich's clinic, are interesting and important. He obtained a pseudo-diphtheria bacillus from pleuritic pus, 5 c.c. of a bouillon culture of which gave no reaction when injected into a guinea-pig. He inoculated a guinea-pig with a culture of this bacillus mixed with diphtheria toxin. Then he cultivated the bacillus on media, and inoculated it again mixed with diphtheria toxin. He repeated this process a number of times, and at length obtained a culture which was highly virulent. This would indicate that the diphtheria bacillus and the pseudo-diphtheria bacillus are really one organism.

This bacillus being found in the mouths of half of all individuals examined, Schanz puts forward the view that the Klebs-Loeffler bacillus cannot be the cause of the formation of false membrane, but that,

¹ Berl. klin. Wochenschrift, 1899, xxxvi. No. 1.

² Deutsche med. Wochenschrift, vol. xxiv. p. 522.

lodging in the membrane and growing there, it produces the toxin which gives the general symptoms. The presence of this organism makes the disease a dangerous one. Schanz holds that the xerosis bacillus and the pseudo-diphtheria bacillus are identical. Sławyk and Manicatide¹ made a careful examination of many different stock cultures of diphtheria bacillus with the object of throwing light on the subject of the unity of the diphtheria bacillus.

Of forty-two cultures considered diphtheria, thirty-eight proved to be true diphtheria. These showed a uniform growth on blood-serum, glycerin-agar, gelatin, and potato. On ordinary agar there was more variation in the appearance of the growth. All the cultures were alike virulent, and all were neutralized by diphtheria antitoxin. Their conclusions thus favor the unity of the bacillus.

At the International Congress of Hygiene and Dermography, held at Madrid in April, Loeffler² declared that one can call diphtheria bacillus only such an organism as can produce a toxin which stands in specific relation to the Behring antitoxin, and that all morphological criteria, even the recent granule stain of Neisser, have no value in the recognition of the true diphtheria bacillus. Kraus, Spronck, and Danler expressed their acquiescence in this view.

Myerhof³ made a study of the morphology of the diphtheria bacillus, and comes to the conclusion that we are not yet in a position definitely to classify it either with the schizomycetes or the hyphomycetes. The bulbous masses and branchings are found under too many conditions to be regarded as degenerative forms or anomalies.

Louis Martin⁴ describes improvements in the methods for the production of toxin. A temporary acidity, which occurs in ordinary bouillon cultures of the bacillus diphtheriae, interferes with the production of toxin. This acidity is due to the presence of sugars in the meat and peptone used. Efforts have been made to prevent its development. Roux and Yersin propose aëration of the cultures. Park and Williams made a great step in advance by alkalinizing the bouillon. Spronck proposed using partially decomposed meat. Martin places the macerated meat in a thermostat at 35° C. for twenty hours. He makes the peptone by placing the minced stomachs of hogs in acidulated water and maintaining this at 50° C. for twelve hours. He heats the bouillon made from this to 70° C., alkalinizes according to Park and Williams, and sterilizes by passing through a Chamberland filter. This medium is free from sugar and no acid forms in it, and it is most favorable for

¹ Zeitschrift f. Hygiene, xxix, 181.

² Berliner klin. Wochenschrift, xxv, 367.

³ Archiv f. Hygiene, vol. xxxiii, p. 1.

⁴ Annales de l'Institut Pasteur, vol. xii, p. 26.

the production of toxin. Martin made a very interesting observation. He had eight cultures of bacilli obtained from the throats of children. Twenty-four hour cultures of the bacilli were non-virulent to guinea-pigs, yet when they were grown in this bouillon for six days, the filtered toxin killed guinea-pigs and could be neutralized by diphtheria antitoxin. Martin believes that bacilli which are, nevertheless, true diphtheria bacilli, are often pronounced pseudo-diphtheria on account of non-virulence.

Ehrlich¹ believes that the diphtheria bacilli produce a toxin, which, as long as it remains chemically unaltered, has a definite poisonous strength and a definite value in neutralizing antitoxin. This neutralization, he believes, is a chemical union in which 200 minimal fatal doses for a 250-gramme guinea-pig combine with one unit of antitoxin. The toxin, however, is unstable and partly changes to substances which are not acutely poisonous, but which retain their power of combining with antitoxin. He classifies these substances as (1) protoxoids, those having greater affinity for antitoxin than toxin itself; (2) syntoxoids, those having equal affinity, and (3) epitoxoids, those having less affinity. The absolute amount of toxin in a quantity of bouillon does not show its neutralizing power with antitoxin. The experiments of Park and Atkinson² agree with Ehrlich's as to the variation of a minimal fatal dose in neutralizing power. They do not uphold Ehrlich's theory of toxoids. Other theories would explain the facts as well; thus, the diphtheria bacillus may produce allied toxins, one having greater neutralizing power and being more resistant.

They found that the relation between the minimal fatal dose and the neutralizing power differed in cultures of different bacilli, but in two cultures of the same bacillus in different bouillons, at the period of greatest toxicity, the relation was very constant. They believe that Ehrlich has contributed greatly to uniformity by calling attention to the necessity of selecting a suitable toxin and distributing an antitoxin to test toxins by.

Most laboratories, however, have taken the culture fluid at the time of greatest toxicity, about six days, when the neutralizing value of a fatal dose seldom varies over 10 per cent.

J. Bernheim³ studied mixed infections of *bacillus diphtheria* and *streptococcus pyogenes*. It is known from clinical experience that the mixed infection heightens the severity of the symptoms and increases the mortality, and that diphtheria antitoxin is not so efficacious in such cases as against the Klebs-Loeffler bacillus alone.

¹ Deutsche med. Wochenschrift, vol. xxiv, p. 597; also Journ. of Pathology, vol. v, p. 489.

² Journ. Exper. Med., vol. iii, p. 513.

³ Archiv f. Hygiene, vol. xxxiii, p. 35.

The question is, Does the streptococcus heighten the virulence of the diphtheria bacillus, or does the streptococcus toxin itself cause the difference? Bernheim found that if animals received the antitoxins of both the diphtheria bacillus and the streptococcus, they showed symptoms no worse when inoculated with the mixed toxins than when inoculated with the diphtheria toxin alone.

Paul Hilbert¹ studied the same problem in a different way. It has been found that in diphtheria cultures alkali production is nearly always proportional to toxin production. The streptococcus does not produce alkali. Hilbert found that alkali production occurred earlier and was more abundant in mixed cultures than in pure cultures of diphtheria. Filtered bouillon from mixed cultures killed guinea-pigs earlier than that from the pure cultures. Diphtheria antitoxin protected perfectly animals inoculated with the mixed cultures. From these experiments Hilbert claims to have proved that the streptococcus acts by increasing the virulence—that is, the toxin production of the diphtheria bacillus. His animal experiments, however, do not rule out the action of the streptococcus toxin itself.

The experiments of these two investigators make it seem highly probable that increased severity of the symptoms is due, not to a heightening of the virulence of diphtheria alone, nor to the streptococcus toxin alone, but to the two factors together.

D. Riesman² reports two cases: 1. A bacteriologist using a pipette drew a few drops of a virulent culture of diphtheria bacillus into his mouth. Forty hours later a white membrane appeared on both tonsils, constitutional symptoms developed, and diphtheria bacilli were found in the throat. Recovery after antitoxin. The case is interesting, as the period of incubation was exactly determined. The conditions were favorable for rapid development.

The second case was one of diphtheria in a child of eleven days. Diphtheria in early infancy is very rare. Henoeh, in 1403 cases collected, found none under three months. Feer, in 4250 cases, in Basle, found seven under three months. Only 2.6 per cent. of the whole number were under one year. The causes of this exemption are: (1) slight opportunity for infection; (2) antitoxic properties of the blood of infants, as proven by Fischl, von Wünschheim, and other observers; (3) absence of catarrhs of the upper air-passages.

Simon Flexner and H. B. Anderson³ made a study of the results of intratracheal inoculation of the bacillus diphtheriae in rabbits. In the first series they allowed the animals to live as long as possible, and this

¹ Zeitschrift f. Hygiene, vol. xxix. p. 157.

² Philadelphia Medical Journal, i. 423.

³ Bulletin Johns Hopkins Hospital, ix. 72.

series showed that the Klebs-Loeffler bacillus is capable of setting up a wide-spread pneumonic process. In certain cases pneumonia did not develop. The animal may succumb to intoxication before pneumonia has developed, illustrating the effects of absorption of poisonous products from the lung substance. The bacilli themselves may be widely spread in distant organs.

In the second series the animals were killed at intervals to determine the manner in which the bacilli disappear, and to study the development of the pneumonic process. At one hour there were oedema and emigration of leucocytes and some of the bacilli were already enclosed in the alveolar epithelial cells. At three and a half hours the bacilli were nearly all in the cells. At twelve and eighteen hours they could still be cultivated, but after twenty-four hours they had completely disappeared. At this time there was frank consolidation. Bacilli were not found in the polymorphonuclear leucocytes. The pneumonias were lobular or pseudo-lobar. They were cellular for the most part, fibrin playing a relatively inconsiderable rôle.

Metin¹ inoculated rabbits and guinea-pigs with emulsions in bouillon of serum cultures of diphtheria bacillus. At intervals he examined the blood for organisms, and found that they had completely disappeared in an hour, being engulfed by phagocytes. Animals were killed at intervals and the organs examined, and bacilli were found only in the spleen, and but rarely even there. They increased slightly as death approached. When he inoculated with mixtures of diphtheria bacilli and streptococci or of diphtheria bacilli and staphylococci, he found that the diphtheria bacilli, as well as the other organisms, increased in number in the blood and in the organs.

Symptoms. **LEUCOCYTOSIS.** Besredka² studied leucocytosis in diphtheria experimentally and clinically. He found that the count of polynuclear leucocytes was always characteristic, although the count of total leucocytes was not. When a rabbit received a very large dose of toxin, the polynuclears increased up to twelve or sixteen hours, and then decreased regularly. After a smaller dose there was always an increase of polynuclears, but the curve showed oscillations. During the immunization of a goat by repeated small doses of toxin there was an increase in the polynuclears after each injection, the rise being less and less marked as immunization advanced. Animals inoculated with toxin and saved with antitoxin showed a polynuclear leucocytosis lasting from twelve to fifteen days after the injection of antitoxin.

The same thing was observed in children treated for diphtheria. The normal low count of polynuclears in children must be taken into

¹ Annales de l'Institut Pasteur, xii. 596.

² Ibid., xii. 305.

account. Children with diphtheria which goes on to a fatal termination in spite of antitoxin fail to show the characteristic polynuclear leucoeytosis. He regards this as a most valuable prognostic sign. These experiments tend to bring diphtheria into line with the majority of infectious diseases in respect to polynuclear leucoeytosis. Diphtheria has the individual peculiarity of showing a decrease in mononuclears.

NERVOUS PHENOMENA. Muraviev¹ (Murawjeff) made a series of experiments to determine the action of diphtheria toxin and antitoxin on the nervous system of the guinea-pig. Soon after injection of the toxin degenerative changes appeared in the cells of the anterior horns studied by Nissl's method. Restitution occurred later, and at the time paralysis began, in the second month after injection, only a few cells showed changes. Up to the third week there were no changes in the peripheral nerves, but at the time of the paralysis a multiple neuritis had developed. Injections of antitoxin alone produced slight degenerative changes in the cells of the anterior horn and in the peripheral nerves. The larger the quantity of antitoxin injected the more were these marked.

When antitoxin was injected with the toxin in full neutralizing dose, the nervous system remained nearly normal. When antitoxin was injected later, there was more and more marked degeneration in the cells and nerves. When given seven days after the toxin it had no effect in checking the degenerative changes. As antitoxin itself is not harmless in large doses, he advised that it be given rather in repeated small doses.

Frederick J. Batten² studied the pathology of diphtheritic paralysis in the human subject. He examined five cases of paralysis, ranging from forty-three to one hundred days from the beginning of illness. He used Marchi's method, as he found that the characteristic appearance of degeneration by this method is not produced by post-mortem change. In the cases examined he found a parenchymatous degeneration in the myelin sheath of the peripheral nerves, sensory and motor. He found no changes in the nerve cells when studied by Nissl's method. He thinks the changes described by Muraviev (Murawjeff) in the cells of the anterior horn may have existed earlier in his cases and then disappeared, as they were all of over six weeks³ standing.

Thomas⁴ found changes in the peripheral nerves in diphtheritic paralysis, varying from a granular and broken condition of the sheath up to a disappearance of sheath and axis cylinder.

G. Sims Woodhead¹ spoke on post-diphtheritic paralysis at the Edin-

¹ Fortschritt der Med., vol. xvi, p. 93.

² British Medical Journal, 1898, vol. ii, p. 1540.

³ Boston Medical and Surgical Journal, vol. cxxxviii, pp. 76, 97, 123.

⁴ British Medical Journal, 1898, vol. ii, p. 593.

burgh meeting of the British Medical Association. Paralysis appeared in thirteen guinea-pigs used in testing the strength of antitoxins, at from six to twenty-five days after injection of the toxin. He found that paralysis occurred more frequently after large doses of toxin.

He quotes Paul Ehrlich¹ as holding the view that in the diphtherial poison there are certain substances present along with the toxins and that these are formed by a rearrangement of the molecules of the toxins. Some of these substances have less affinity for antitoxin than do the true toxins, and they do not combine with antitoxin until all the true toxins have been satisfied. These substances he calls epitoxoids. If large quantities of poison have been absorbed, these epitoxoids may be present in large amount after the true lethal toxins have all been neutralized. "We should, therefore, expect that if some such substance as this be the cause of the paralysis, the greater would be the proportion of paralysis as the test dose of the poison becomes larger." He found that the antitoxin itself did not produce paralysis. Paralysis did not occur in guinea-pigs which were given very large doses of antitoxin.

He thought that the practical outcome was that the antitoxin should be used before degenerative changes were set up, and that enough should be given to neutralize not only the lethal action of the poison, but also its local and paralysis-producing action.

E. W. Goodall said that paralysis had increased since antitoxin was introduced, but it was because patients now lived to show paralysis, who, without antitoxin, would have died at an earlier period. At the Metropolitan Asylum Board's Hospitals the cases of post-scarlatinal diphtheria, being under observation from the very beginning, received antitoxin early, and these cases showed a considerably smaller percentage of paralysis than did cases admitted from the outside.

Joseph McFarland² insists on the necessity of giving large doses of antitoxin. He showed that guinea-pigs which are partially protected with antitoxin exhibit paralysis after injection of toxin, while thoroughly protected animals do not.

J. English³ reports a case of diphtheritic paralysis of the bladder, a very rare condition. There was incontinence of urine for fifteen years. No paralysis elsewhere.

HEART COMPLICATIONS. Hibbard⁴ investigated the heart complications in 800 cases of diphtheria. When the pulse-rate was over 150 the mortality was 50 per cent. Irregularity of pulse showed a mortality of 47 per cent. Slow heart did not appear to be dangerous except in chil-

¹ Deutsche med. Wochenschrift, vol. xxiv, p. 597.

² New York Medical Journal, vol. lili, p. 8.

³ Wiener med. Presse, xxxix, 330.

⁴ Boston Medical and Surgical Journal, cxxxviii, 73, 100.

dren. Cases dying of a cardiac failure always showed degeneration of the pneumogastric nerve.

H. D. Chapin¹ insists upon the necessity of carefully watching the action of the heart in diphtheria. Children frequently lose their lives because they cannot be kept quiet. Small doses of morphine are most effectual in this condition.

Other Sequelæ and Complications. J. Whitridge Williams² reports a case of diphtheria of the vulva in which the Klebs-Loeffler bacillus was demonstrated. Recovery took place after antitoxin was used. He states that there are on record only two cases of diphtheria of the vulva, properly confirmed by bacteriological examination. So-called diphtheritic endometritis and puerperal diphtheria have nothing to do with true diphtheria. *Streptococcus pyogenes* may cause a pseudo-diphtheritic membrane in any part of the genital canal.

Freyrnuth and Petruschky³ report a case of vulvitis gangrenosa (noma genitalium) in which the diphtheria bacillus was found. Recovery after antitoxin occurred in this case also.

They report a second case⁴ of diphtheritic noma, this time of the face. They believe that the condition is common.

Frederick Smith⁵ demonstrated diphtheria bacilli in the urine of guinea-pigs inoculated with cultures of the bacillus.

Diagnosis. J. Simon and E. Benoit⁶ investigated an epidemic of diphtheria occurring in barracks at Lyons. One hundred and eight soliders were examined. The Klebs-Loeffler bacillus was found in 32, and of these 9 had simple angina and 11 had no symptoms. The more outspoken the inflammation of the mucous membrane the more numerous and virulent were the bacilli. Roux and Yersin found diphtheria bacilli in 26 out of 59 healthy school children. Meade Bolton found them in 41.5 per cent. of 234 persons examined.

Westbrook⁷ investigated a school in which diphtheria was endemic: 478 persons were examined, and diphtheria bacilli found in 172. Of these, 59 had no sore-throat. An atypical bacillus was found which took longer to kill guinea-pigs than does the Klebs-Loeffler bacillus.

E. Fränke⁸ finds that the xerosis bacillus gives a more abundant growth on Loeffler blood-serum and peptone-agar than does the diphtheria bacillus. In bouillon the diphtheria bacillus causes an acid reaction, the xerosis bacillus an alkaline, while the pseudo-diphtheria bacillus as found

¹ New York Medical Record, liii. 77.

² American Journal of Obstetrics, xxxviii. 180.

³ Deutsche med. Wochenschrift, xxiv. 232.

⁴ Ibid., 600.

⁵ Lancet, November 19, 1898.

⁶ Revue de Médecine, xviii. 48.

⁷ British Medical Journal, 1898, i. 1008.

⁸ Münchener med. Wochenschrift, xlv. 487.

on the conjunctiva does not alter the reaction. Franke could not make a distinction between the xerosis bacillus and the Hoffmann-Loeffler pseudo-diphtheria bacillus of the throat.

II. Heinersdorf¹ examined many cultures of the diphtheria-like bacilli to determine the value of the differential stain recently proposed by Max Neisser. The procedure is as follows. Two solutions are used:

1. One gramme of methylene-blue (Grübler's) is dissolved in 20 c.c. of 96 per cent. alcohol. To this are added 950 c.c. of aq. dest. and 50 c.c. of glacial acetic acid.

2. Two grammes of Vesuvium are dissolved in 1 litre of boiling water, and the solution is filtered. Cultures must be made on Loeffler blood-serum and kept in a thermostat at 34° to 36° C. for nine to twenty-four hours. Stain for one to three seconds in solution 1; wash in water. Stain for three to five seconds in solution 2; wash in water.

By this stain granules are brought out in the Klebs-Loeffler bacillus which are not seen in the pseudo-forms.

Heinersdorf found that nine to sixteen-hour cultures which show the granules typically, in bacilli of typical form, are of Klebs-Loeffler bacilli. In nine to sixteen-hour cultures the xerosis bacillus shows no granules. In cultures of over twenty-four hours granules may appear, but not typically.

Auekenthaler² found Neisser's granules in all cultures of Klebs-Loeffler bacillus. He recommends staining for ten to fifteen seconds in the methylene-blue solution. Several smears should be looked over. He found granules in small number in one culture of pseudo-diphtheria bacillus. He finds Neisser's method of great practical value, but not absolute.

Richard J. Hewlett³ found that Neisser's method applied in all cultures examined.

II. Kurth⁴ reports observations made at the Bacteriological Institute at Bremen on the recently proposed methods for the rapid recognition of the diphtheria bacillus and for the differential diagnosis between the diphtheria bacillus and its "Doppelgänger." Six hundred and eighty-four examinations were made, in which the diagnosis was diphtheria 329 times. Pure cultures of diphtheria bacilli were obtained 45 times, and of allied forms 52 times.

Czaplewski's plan of staining fresh smears by Gram's method gave positive results in one-third of all cases of diphtheria. Although the pseudo-diphtheria bacilli take the Gram stain, yet they are in such small number in a fresh smear that they do not often cause any difficulty.

¹ Centralbl. f. Bacteriologie, xxiii. 397. ² Ibid., 641.

³ British Medical Journal, 1898, ii. 599.

⁴ Zeitschrift f. Hygiene, xxviii. 409.

There can be no doubt of the usefulness of Neisser's method. In certainty it nearly equals the inoculation of an animal, and the examination of cultures by this method should never be omitted. He holds that the finding of the granules makes sure the diagnosis of diphtheria. However, in three undoubted cultures of the diphtheria bacillus the granules were wanting. He found the length of the bacilli and their arrangement in V-shaped groups of value in making a differential diagnosis of pure cultures. The formation of acid in considerable amount in glucose bouillon is a weighty and constant characteristic of the diphtheria bacillus. The antitoxin test is absolutely final. If guinea-pigs inoculated with the suspected bacillus die, while others inoculated but treated with antitoxin recover, no possible doubt remains.

These studies have an important practical bearing. It is shown that a bacillus must not be called pseudo-diphtheria on account of the morphology or even lack of virulence. Unless it is proved that a suspected bacillus does not produce a toxin which is antagonized by diphtheria antitoxin, it is safer to regard it as true diphtheria and treat the case accordingly.

Treatment. ANTITOXIN. Statistics continue to be published showing decreased mortality under treatment with antitoxin.

J. H. McCollum¹ reports that the mortality of diphtheria in Boston from 1880 to 1884 was 30.75 per cent.; from 1895 to 1897 it was 12.61 per cent.

Albert Woldert² goes over the diphtheria statistics of Philadelphia, and finds great variations from year to year. In the total cases of diphtheria are now included many cases of angina showing the bacilli, which formerly would not have been classed as diphtheria. On the other hand, many cases clinically like diphtheria are now excluded because of absence of diphtheria bacillus. He thinks that these two classes about balance each other. He concludes that it is too early to judge of the value of antitoxin from statistics. Antitoxin is not given as frequently as it should be.

H. Kossel³ shows that the fall in mortality of diphtheria, in large German cities and in Paris, has been more pronounced than any fall on record due to change in virulence of the disease. The total of deaths has fallen one-third. At the Charité Hospital, Berlin, the total deaths have fallen one-half.

F. A. Dixey⁴ examined the statistics of the Registrar-General for London. The percentage of mortality has decreased since 1894 from

¹ Boston Medical and Surgical Journal, cxxxix, 153.

² Medical News, lxxiii, 393.

³ Deutsche med. Wochenschrift, xxiv, 229.

⁴ British Medical Journal, 1898, i, 611.

23.6 to 17.7. The total cases and total deaths have been very high, but have decreased slightly since 1896.

Kretz¹ investigated a series of 1989 cases. Before the introduction of antitoxin the mortality was 40 to 46 per cent., afterward the mortality was 19 to 25 per cent. In the former series 33 per cent. died from complications, in the latter series 50 per cent. died from complications.

Rauchfuss² examined the statistics of serum-therapy in Russia. The total number of cases and deaths has increased very considerably since 1894; 25,821 cases treated with antitoxin have a mortality of 14.7 per cent.; 14,274 cases treated without antitoxin have a mortality of 40 per cent.

Baginsky³ reports his experience with antitoxin at the Kaiser- und Kaiserin-Friedrich-Kinderkrankenhaus, in Berlin, since his report in 1895. There were 799 cases with 74 deaths. Like other observers, he finds the efficacy of antitoxin greatest when given early in the disease. In the cases where the date of onset could be fixed with reasonable certainty, the mortality when antitoxin was given on the first day was 1.07 per cent.; on the second day, 2.08 per cent.; on the third day, 5.70 per cent.; on the fourth day, 20.7 per cent.; 258 cases showed laryngeal stenosis, and 113 of these recovered without operation. Intubation was done in 103, with a mortality of 8.73 per cent. Tracheotomy was done in 14 primarily, with 10 deaths, and in 22 after intubation with 15 deaths. Heart complications were most frequent in those who received antitoxin late. Immunization of children exposed was carried out in 482 cases in hospital and private practice. In 15 of these diphtheria afterward developed. He advises that immunization be invariably done in institutions where children are constantly coming and going. In private practice he does not insist on it, as the exposed children can be carefully watched and antitoxin given early if diphtheria develops. Baginsky declares that, through antitoxin, diphtheria has at last lost its terrors, just as smallpox has through vaccination. In smallpox it is prophylactic, in diphtheria really curative.

Kassowitz⁴ makes an attack on antitoxin, which has received a great deal of attention. He denies that statistics show any value for it, and says that the percentage of mortality is lower because many cases are listed now as diphtheria, on account of bacteriological examination, which formerly would not have been called diphtheria. These latter are usually mild cases. The total cases in hospital statistics will be found increased. Turning to the total number of deaths he says that this has always

¹ Wiener klin. Wochenschrift, ix, 20.

² Arch. de Médecine des Enfants, i, 641.

³ Arch. f. Kinderheilkunde, xxiv, 321.

⁴ Wiener klin. Wochenschrift, xi, 569; also Therapeut. Monatsheft, xii, 305.

varied much from year to year. This can account for the reduction of total deaths in Vienna, Paris, and many German cities. Absolute mortality has not changed in Moscow, London, and New York, and it has increased in St. Petersburg and in Trieste in 1894, showing the powerlessness of antitoxin in a real epidemic. He points out the high mortality in Baginsky's tracheotomies (74 per cent.). He doubts the relation of the Klebs-Loeffler bacillus to diphtheria.

Baginsky¹ replies to Kassowitz. He shows that in his hospital the number of cases of diphtheria was smaller in 1896-97 than in 1892-93: in 1892, 325 cases, mortality, 36.1; 1893, 422 cases, mortality, 42.1 per cent.; 1893, 319 cases, mortality, 9.09 per cent.; 1897, 304 cases, mortality, 8.6.

The cases are not milder than in former years. As to absolute mortality, he points out that the serum generally used in London was of inferior quality, as was proved by the investigations of the *Lancet*, July 19, 1896. One much-used brand required 300 c.c. of serum to get 3000 units of antitoxin. As the usual dose was 10 to 20 c.c., the amount of antitoxin given was entirely insufficient. The statistics of London cannot, therefore, be used against antitoxin. In Russia also the serum was of inferior strength. Baginsky shows that his high mortality in tracheotomy was due to the fact that this operation is now used as a last resort, intubation being preferred in ordinary cases of stenosis of the larynx. His mortality in intubation up to the present is only 3 per cent.; formerly it was 41.8 per cent.

Josef Körösy² combats the reasoning of Kassowitz. In Trieste those treated with antitoxin showed a mortality of 14.2 per cent., while those treated without it had a mortality of 40.7 per cent.

Morrill³ writes on the subject of immunization against diphtheria. Two hundred and fifty units must be given to a child under two years, and 500 units to a child of over eight years. It must be repeated every twenty-one days; no harm results.

Slawyk⁴ states that since 1894 all children entering the Charité Hospital in Berlin have received inoculations, except during the fall of 1897. Four cases of diphtheria developed when no injections were given, and none during the other periods. The injection must be repeated every three weeks.

H. M. Donald⁵ reports three epidemics of diphtheria in an orphan asylum. In the first, seven cases developed. The remaining eighty-

¹ Berliner klin. Wochenschrift, xxxv. 589.

² Therapeut. Monatsheft, xii. 502.

³ Boston Medical and Surgical Journal, cxxxviii. 193.

⁴ Deutsche med. Wochenschrift, xxiv. 85.

⁵ New York Medical Journal, lxxvii. 715.

seven children each received 250 units of antitoxin, and but one more case developed. In the second epidemic five cases appeared, but none after immunization. In the third, six cases appeared, while one developed after immunization.

W. T. Watson¹ reports forty-six intubated cases of diphtheria treated with antitoxin, of which the mortality was 19.5 per cent. The recovered cases were of all grades of severity, and of the nine fatal cases four were practically moribund at the beginning of treatment. In one case the tube became blocked with a tough piece of membrane. One died of broncho-pneumonia four days after the tube had been removed and laryngeal symptoms had disappeared. The other three cases received antitoxin and were intubated early, but died of lung complications. Antitoxin and intubation have reduced the death-rate in laryngeal stenosis from nearly 100 per cent. to 27 per cent. This is still too high, and will be reduced when physicians are more impressed with the importance of early use of antitoxin and early intubation. Intubation should be performed with the first advent of dyspnea. In some cases where dyspnea is slight, a large amount of mucus will escape from below the glottis during and after intubation. It is possible that this mucus, if allowed to accumulate, may be the means of conveying infection to the lungs. Intubation should be done by the general practitioner, as no time should be lost.

L. I. Matthews² reports thirteen cases of membranous croup treated with antitoxin, in which there were only two deaths. These cases belonged to the class characterized by mild constitutional symptoms. Matthews thinks these cases are not contagious, and doubts their identity with true diphtheria. It seems more logical to regard them as mild cases of diphtheria which are serious only on account of the location of the false membrane in the larynx. Antitoxin is of special value in these cases.

It is strange and melancholy still to hear occasional expressions of doubt as to the efficacy of antitoxin. Few points are better proved theoretically and practically than the value of diphtheria antitoxin in practice. Enlightened clinical experience has shown that if promptly recognized and immediately treated, the disease has, indeed, as Baginsky says, almost lost its terrors. As yet but a small proportion of all cases have the good fortune to come under the observation of those who recognize this fact. But it is to be hoped that this may not long be true, and that the day is not far off when the general mortality from diphtheria may fall to a point even lower than that reached in the wards of this distinguished clinician (8.6 per cent.).

¹ Bulletin Johns Hopkins Hospital, ix. 146.

² Therapeutic Gazette, xxii. 580.

C. J. Martin and Thomas Cherry¹ studied the nature of the antagonism between toxins and antitoxins. The question whether the antitoxins act directly on the toxins in a simple chemical reaction or through action of the animal cell, remains open. Behring, Ehrlich, and Kanthack favor the chemical view. Buchner, Roux, and Metschnikoff hold the opposite. Experiments by Calmette and by Wassermann seem to show that when toxins and antitoxins are mixed *in vitro* no reaction occurs before inoculation, for it is found that if the free antitoxin be removed from the mixture before inoculation the animal dies, thus showing that the toxin has remained intact. The experiments of Martin and Cherry directly contradict this conclusion. Diphtheria toxin will pass through a gelatin filter, while the antitoxin will not. They mixed the two, kept them at 30° C. for two hours, and then filtered through gelatin to remove the free antitoxin. Guinea-pigs inoculated showed no symptoms.

They also made a series of experiments with the venom of the Australian tiger snake and Calmette's antivenomous serum. The antitoxin is here destroyed by heating to 68° C. for ten minutes. The venom and antitoxin were mixed in various proportions and kept for from two to thirty minutes. Then the mixture was heated to 68° for ten minutes and injected into guinea-pigs. It was found that there had been reaction of antitoxin on the venom, which varied according to the amount of antitoxin and the length of time they were in contact. They attribute the discrepancy between their results and those of Calmette to the fact that he took no account of time as a factor.

Bomstein² studied the same subject and came to the opposite conclusion. He found that by mixing 0.5 c.c. of toxin, ten times the minimal dose, with 0.001 c.c. of antitoxin and injecting into a guinea-pig of 250 grammes, no effect was produced. If now he took five, four, three, and two times this dose of the mixture, preserving the same relative proportions, the animals died. This would indicate that the reaction is not a simple chemical one. He also mixed 1 c.c. of toxin and 0.002 c.c. of antitoxin, kept this for twenty-four hours at 22° and 37°, and then injected it into guinea-pigs. At the same time he injected equal quantities, freshly mixed, into guinea-pigs of equal weight. They all died after the same length of time. This indicates that no action took place extracorporeally. Evidently the problem remains to be solved.

F. Henke³ injected diphtheria bacilli into guinea-pigs and inoculated them with antitoxin at various intervals afterward. The effects were favorable up to twenty hours, but when the animals received the antitoxin later than this it had little or no effect.

¹ British Medical Journal, 1898, i. 112.

² Centralbl. f. Bacteriologie, xxiii. 785.

³ Arch. f. patholog. Anatomie (Virchow), vol. cliv. p. 233.

Henry W. Berg¹ studied the *serum exanthemata* in the antitoxin treatment of diphtheria. Exanthemata occurred in 11 per cent. of cases treated. They are due to toxic action of the horse's blood-serum and not to the antitoxin itself. There is hyperemia resembling scarlatina or measles. This may be due to the excretion of the irritant elements of the serum by the sweat-glands. Berg found that filtration of the antitoxic serum through a fine Chamberland filter lessens the frequency of these eruptions.

Cobbett² showed that filtration sometimes, but not always, seriously impairs the value of diphtheria antitoxin.

At the Pasteur Institute it was recently determined, by experiments on the cow, that horse-serum lost its toxic properties when heated to 58° C. Spronck³ confirmed these observations in the human subject. The antitoxic serum, in rubber-stoppered bottles, was placed in cold water which was then heated to 59° in half an hour. It was kept at this temperature for twenty minutes. There was found to be very slight interference with the antitoxic action.

In 1895 and 1896, of 1365 cases treated in two large hospitals in Amsterdam and Haarlem with unwarmed serum, 208 cases (15.2 per cent.) showed injurious accompanying effects. During seven months of 1897, of 251 cases treated with warmed serum, only 12 (4.7 per cent.) showed bad effects. The mortality was 18.5 per cent. in 1895-96, and 13.1 per cent. in 1897.

Harold C. Ernst⁴ tried the effect of alternately freezing and thawing antitoxic serum. He found that when this process had been carried out daily for eight or twelve days, the upper portion of the column had lost its antitoxic power, while the lower portion was proportionately stronger. This property may be of value in obtaining serums of high potency.

F. Abba⁵ finds that antitoxin remains unchanged when kept for a year and a half, and that it loses but little in strength even after that.

Behring has patented his antitoxin in the United States. All the American medical journals have made editorial comments on the subject. In general, they severely criticise Behring for applying for the patent and the Patent Office for granting it. The credit does not belong to Behring alone. Bacteriologists have been working up to the production of antitoxin for many years, and without their work the achievement of Behring would have been impossible.

¹ New York Medical Record, liii, 865.

² Centralbl. f. Bacteriologie, xxiv, 386, 415.

³ Nederl. Tijdschrift o. Geneeskunde, 1898, 690; also Annales de l'Institut Pasteur, xii, 696.

⁴ Trans. Association American Physicians, vol. xiii, p. 333.

⁵ Centralbl. f. Bacteriologie, vol. xxiii, p. 934.

Behring puts forward the feeble plea that the patent will prevent inferior preparations from being placed upon the market.

It is sad to see one of such ability willing to barter his good fame for mere commercial profit.

ANTITOXIN ADMINISTERED BY THE MOUTH. Fisch¹ gave the milk of animals, made immune by repeated injections of diphtheria toxin, to puppies and kittens, rendering them immune. Antitoxin was taken by the mouth, by four men, and found antidotal to diphtheria toxin. In the animals and men experimented upon the immunity did not appear until twenty-four to thirty-six hours after administration. This mode of treatment is, therefore, restricted in its use.

John Zahorsky² studied the effects of antitoxin given by the mouth. It required twenty-eight to thirty-six hours to show effects, but its therapeutic value was definite. At times, however, it does not seem to be absorbed. It should be employed only in mild cases and where there are objections to its hypodermic use. For prophylaxis, it is to be recommended in doses of from 400 to 1000 units. Strange to say, urticaria developed in 5 of 49 cases and joint pains in 3. Further observations are necessary before this can be accepted, as it has been shown that the exanthemata are due to toxic properties of horses' serum when injected into the blood.

TREATMENT WITH SERUM OF CONVALESCENTS. Weisbecker³ treated thirty cases of diphtheria with injections of serum of convalescents, and had three deaths. There was improvement in general symptoms and lowering of temperature.

DURABILITY OF IMMUNITY. William Bulloch⁴ tested the durability of diphtheria immunity. Twenty-five thousand units of antitoxin were injected into the subcutaneous tissue of an ass, and the blood of the animal was tested from time to time for antitoxin. It appeared in the blood immediately, and increased up to twenty-four hours. From that time there was rapid decrease to the fourth day, after which the decrease was slow. At one hundred days antitoxin was still present but in very minute quantity. Examinations of the urine showed that the antitoxin was not eliminated in that way.

CHLORINE; NITRATE OF SILVER. P. M. Bracelin⁵ recommends the inhalation of chlorine gas prepared according to a special formula which he has not yet given in full. A "corrective" is added, consisting of menthol, camphor, eucalyptol, and salicylate of methyl, whose object is to prevent the irritation and suffocative effects of the chlorine.

¹ New York Medical Journal, vol. lxvii. p. 489.

² *Ibid.*, p. 392.

³ Münchener klin. Wochenschrift, September 27, 1898.

⁴ Journal of Pathology and Bacteriology, vol. v. p. 274.

⁵ New York Medical Journal, lxxiii. 329, 747.

P. David Schultz¹ has made a trial of the above preparation, and finds it of great value.

Chlorine has long been used in the treatment of diphtheria. This new preparation is claimed to be superior to that made in the ordinary way, on account of increased bactericidal power and freedom from irritative effect.

Alfred J. Hand² recommends silver nitrate, 60 grains to the ounce of water, for clearing the throat of diphtheria bacilli.

BUBONIC PLAGUE.

The epidemics at Hong-Kong and in India have given abundant opportunities for the study of this disease. The bacillus pestis was first found and described by Kitasato during the Hong-Kong epidemic in 1894, and shortly afterward it was described by Yersin, working independently. In September, 1896, an epidemic was recognized at Bombay, on the western coast of India, the disease spreading through the city and presidency of Bombay, and over a large part of India. The epidemic was at its height during the winter months of 1897, and gradually subsided as summer approached; a second epidemic, however, occurred a year later, which was even more destructive than the first. A third epidemic followed, which was at its height in October, 1898, but has been gradually subsiding.

From September, 1896, to October 14, 1898, there were 158,379 cases, with 125,239 deaths.

At a meeting of the British Medical Association, W. J. Simpson³ spoke of the various epidemics of plague in India. The Justinian plague, in 542, arose in⁴ Egypt and Ethiopia, and spread to Europe and then eastward to Syria, Persia, and India. In 1684-1702 there was a general eruption in Western India, including Bombay. Of 800 Europeans only fifty escaped. The Levant and adjoining countries have been centres for three thousand years. The Chinese plague is active and expansive in distinction to the Levantine, which is not inclined to spread. Simpson insists on the necessity of a trained sanitary service in India, organized in three branches: (1) administrative; (2) investigative; (3) scientific. He believes the plague has come to India to stay for some time.

Koch,⁴ who was at the head of the German Plague Commission, gives an interesting account of the discovery of a hitherto unknown centre.

¹ New York Medical Journal, lxxviii. 675.

² Philadelphia Medical Journal, vol. ii. p. 432.

³ British Medical Journal, 1898, ii. 853.

⁴ Deutsche med. Wochenschrift, xxiv. 437.

Ten years ago it appeared that the plague had only an historical significance; it had not, however, completely disappeared, for one heard of small outbreaks in Mesopotamia. Then uncertain reports came that plague existed in China, and in 1894 it appeared on the coast at Hong-Kong. Here it was possible to study the disease by modern scientific methods. Two years ago it broke out at Bombay and rapidly spread over a large part of India. One case appeared even in London, and a ship with several cases on board was held in quarantine at Suez.

These epidemics have given opportunities for the thorough study of the disease, and we have learned that plague is caused by a bacillus by which animals can be infected. Much has been learned as to natural and artificial immunity. We have learned that rats are very susceptible, and that they play an important part in the spread of the disease. One point, however, has not been sufficiently studied, namely, the origin of the disease. The plague must have a seat in some place where it is endemic, and from which it spreads to other lands. Some of the early epidemics have been traced through Asia Minor to Mesopotamia. The Chinese epidemic has been proven to have sprung from southwestern China, the mountainous Thibet. Earlier Indian epidemics came from the Himalayas, and probably from the land lying behind them, again Thibet. A third centre lies on the west coast of Arabia, south of Mecca, but no great epidemics have sprung from this centre. There is a fourth centre in the interior of Africa, about which we have been ignorant up to the present.

While in Africa Koch heard that there existed in Kisiba a disease called *Ruburunga*, the symptoms of which resembled those of the plague. As Koch wished to determine the nature of this disease, Zupitza volunteered to make the journey there, a march of several months, study the disease, and bring back material. He accomplished his purpose, observing the symptoms, making autopsies, and bringing back the material and the bodies of rats spontaneously infected. He also made experiments on animals. The symptoms were those of bubonic plague—sudden onset with chills, high fever, headache, and rapid loss of strength. Buboës in the inguinal, axillary, or cervical regions soon appeared, and nearly all cases died. The demonstration of the bacillus *pestis* in all cases, in the lymphatic glands and in the spleen, made the diagnosis certain. Rats died in large number at the beginning of an epidemic, and this was recognized by the natives, as they forsook their huts when the rats began to die. Kisiba is not the real plague centre, but is only on the outskirts. The real centre is to the north, in Uganda, in British East Africa, where it has evidently existed for ages. There is no danger of spread to the south, as there is no traffic in that direction. It is probable that the epidemics in Egypt and Tripoli were carried

from this centre by transportation of slaves from the upper Nile. Toward the east there is now no traffic, but a railroad about to be built from the British African coast to Uganda will bring this centre nearer to the world. However, Koch thinks there need be no great apprehension, as the plague has been steadily pushed back by advancing civilization, and we may hope that this infection will be gradually crowded back, and finally disappear altogether.

Frank G. Clemow¹ gives an account of the epidemic at Calcutta, beginning April 16, 1898, in which there were 190 cases in all. An epidemic among rats preceded the outbreak. Two hundred thousand persons, one-fourth of the population, left the city in panic, and an attempt to promote voluntary inoculations by Haffkine's method resulted in riots in which several officials were killed. It is difficult to fix the exact date on which the epidemic started, as there exists in India an endemic fever with buboes. This disease is milder than bubonic plague, of low mortality, and not accompanied by disease among rats.

An epidemic of plague occurred at Anzoy, in the district of Samarkand. Over 75 per cent. of the inhabitants succumbed. The Russian Government has taken elaborate precautions to prevent its spread.

C. Stekoulis² and Noury Bey³ give accounts of a second outbreak of plague at Djeddah, a trading town on the Red Sea, sixty miles from Mecca. Regulations could not be carried out, as cases were concealed and bodies buried secretly. The clothes of the dead were distributed among the friends, according to custom. The cases were in the neighborhood of grain warehouses, and the infection was probably brought with grain from Bombay. This is a dangerous centre, on account of its situation.

A small epidemic arose at Prof. Weichselbaum's laboratory in Vienna.⁴ In January, 1897, the Royal Academy of Sciences of Vienna sent H. F. Müller, Albrecht, Ghon, and Poech to Bombay to study the plague. They remained there three months and brought back specimens from fifty-two autopsies. They established a laboratory in a separate building at the Allgemeine Krankenhaus, where they were studying the action of the bacillus and the possibility of immunization. On October 15, 1898, Barisch, the care-taker, developed pneumonia. The sputum was examined and found to contain bacilli of doubtful character. A guinea-pig which was inoculated died three days later, and was found to have enlarged glands containing plague bacilli. On the same day Barisch died, but no autopsy was made, on account of the risk of spreading the disease. On October 20th and 21st the pneumonic form of plague

¹ *Lancet*, 1898, ii. 738.

² *Jahns*, iii. 437.

³ *Annales de l'Institut Pasteur*, xii. 604.

⁴ *Lancet*, 1898, ii. 1165. *Wiener klinische Wochenschrift*, xi. 981.

developed in Albertine Peclia, a nurse, and in H. F. Müller, who had attended Barisch. Müller died on the 23d and the nurse on the 30th. Another nurse contracted the disease, but recovered. Dr. Marmorek came from Paris and inoculated all who had been in contact with these cases with serum prepared by Roux. The laboratory was disinfected and closed, and all the animals were destroyed. The hospital was quarantined, and no more cases developed.

Weichselbaum¹ described the precautions taken at the plague laboratory. The work was done in one room, which did not communicate with any other. Barisch was chosen as "Diener," on account of his intelligence and his previous experience in bacteriological laboratories. Special rules were made for this room. After handling infected animals or objects the hands were washed in a 2 per cent. solution of corrosive sublimate. Instruments were placed in 5 per cent. lysol for twenty-four hours. Excreta were placed in 2 per cent. sublimate for several days, then mixed with sawdust and burned. Tables and floors were washed daily in 2 per cent. sublimate. Cultures were in exclusive control of Dr. Ghon. When an animal died the cage was placed in 2 per cent. sublimate for several days. The last experiment was made ten days before the beginning of Barisch's illness.

The source of his infection is difficult to place. He was intoxicated on October 8th and 9th, and he may have been careless on the following days. He may have broken the rule against smoking in the laboratory, and in that way conveyed infectious material to his mouth, or he may have examined the animal last inoculated and inhaled bacilli dried on its hair.

Etiology and Manner of Infection. E. H. Hankin² writes on the propagation of plague. In spite of the fact that plague is endemic in Gahrwal and Kumaon, in the Himalayas, the plains of India have been comparatively exempt, which is explained by the difficulties of traffic in the mountains. Plague is not so destructive in places where it is endemic, as when it attacks a village the inhabitants immediately forsake their homes and camp for a month. The present epidemic is more wide-spread than previous ones in India, on account of the railroads. The universal opinion of those studying plague in India is that it is carried long distances by man; but that during an epidemic in a town, infection is not ordinarily from person to person, except in the pneumonic form. Friends of patients who spent much time with them were rarely infected. Hospitals in populous districts never become centres of infection. The rat is the most important factor in carrying contagion. At Bombay the plague started in the quarter Mumdvi. Nine weeks later the rats emi-

¹ Oesterreichische Sanitäts-wesen, x. No. 43, 25.

² Annales de l'Institut Pasteur, xii. 705.

grated from this quarter, and immediately afterward the plague appeared wide-spread in the districts to which the rats had gone. If rats are poisoned the others leave the house in panic, thus hastening the spread of the disease. It has been held that lack of fresh air favored the spread of plague, because the lower stories are more affected than the upper, and police and scavengers living in well-constructed barracks are less frequently infected than those living in old houses. These facts are better explained on the ground of accessibility to rats. It seems hopeless to try to kill all the rats in a place, and it is also impossible to evacuate a whole city. Hence it seems impossible to arrest an epidemic when once well started. The results of the efforts of sanitary authorities have been disappointing, yet the mortality in the present epidemic is small when compared to those in London and Marseilles, viz.:

	Population.	Deaths.	Per 1000.
1720, Marseilles	247,000	86,000	348
1665, London	460,000	68,000	149
1896-97, Bombay	846,000	19,849	23

P. L. Simond¹ investigated the manner of infection. It has been suggested that the Bombay epidemic was caused by contagion from Gahrwal, in the Himalayas, but it is more likely that it came from Hong-Kong. The propagation of plague from town to town is probably by man, as in each new town attacked there are always one or more imported cases before any develop among the inhabitants themselves. Inside a town its spread cannot be so explained, as cases appear in houses near and far from those infected, and often in houses where the dwellers have scrupulously avoided all contact with infection. As the epidemic reaches its height its spread becomes even more capricious. The disease extends rapidly along a street, often attacking many houses simultaneously, and frequently appearing in several members of a family on the same day. The insufficiency of human contact as explaining the spread of plague is clearest in small villages. This irregular extension cannot be explained as due to contagion through air, nor through water, as plague does not appear in groups of individuals having the same water supply. The rat is certainly the carrier of infection. The connection between epidemics among rats and the plague in man has been frequently noted. In Formosa the name for plague signifies a disease of rats. The identity of the disease in rats and man is established bacteriologically.

During the recent outbreaks in India, in each town epidemics among rats have almost invariably preceded or occurred at the beginning of the human epidemic. At Kurachee, in March, 1898, the first victims were the employés in grain warehouses. As many as seventy-five dead rats

¹ Annales de l'Institut Pasteur, xii. 625.

have been found in one house on the same day. There were numerous instances where contagion was manifestly from rats. At the beginning of the epidemic in Bombay, a large number of dead rats having been found one morning in a warehouse, twenty coolies were ordered to throw them out, and in three days half of them had contracted the disease. Direct contact with the rat, however, is not necessary, the presence of dead rats in the house being sufficient. At Bombay, of all merchants, those who handle grain and flour have furnished the greatest number of victims. In the houses of Europeans the domestics are the most exposed, and are the most frequently attacked. Europeans are not more exempt than the natives, as the wealthy natives who live after the manner of Europeans are attacked no more frequently than are the Europeans. In the histories of former plagues there is no mention of mortality of rats on shipboard; but during this epidemic, Simond found two instances where cases in men followed an epidemic among rats on shipboard. When infection is carried from one town to another by man, twenty to fifty days always elapse before the epidemic breaks out, the spread of infection among the rats occurring in this period.

Hygienic precautions have checked the spread of plague over long distances, but over short distances the effect is not so marked. Cases rarely develop among European attendants at hospitals, but somewhat more frequently among native attendants. Against the theory of propagation by rats, it has been held that the epidemic among rats ceases before the end of the human epidemic, but this is only apparent. At the height of the epidemic rats are found dead in rooms and in the street, but later on they remain in their holes. Rats captured at this period, after the epidemic is apparently over, show a considerable number infected. In this way Simond was able to show that the epidemic among rats lasted as long as the human epidemic. A careful examination of the epidemic in various localities does not show that season and climate have a marked influence. The severer epidemics, however, are not at the hottest season. The second epidemic appears nearly always exactly one year after the first, and Simond holds that the recrudescence occurs with a new generation of rats.

Our knowledge of the manner of propagation from rat to rat, from rat to man, or from man to man, has been unsatisfactory. It has been generally held that infection of rats was by the digestive tract, from the eating of bodies of rats or infected material. It is generally admitted that infection in man is by the skin or lungs. The view is widely held that infection takes place through excoriations of the skin; but an objection to this is that excoriations are rarely found, and besides, although the bacillus grows readily in pure culture, it is rapidly destroyed by saprophytes when exposed to the air.

Simond caused rats and monkeys to feed on cultures of the bacillus, the organs of rats killed by plague, dejections of rats with plague, intestinal contents of rats dead of plague, and sputum from the pneumonic form of plague. In none of them did plague develop. [Kitasato, Koch, Bandi and Balistreri, and others have made similar experiments with positive results. Sometimes large quantities of the infected material had to be given, and very often infection did not occur; but it can be said that the possibility of infection by the digestive canal has been satisfactorily proven.]

Simond also caused monkeys to inhale dust impregnated with bacilli, with negative result. He applied to excoriations of the skin of monkeys the intestinal contents of infected rats and the sputum of pneumonic cases which had been mixed with earth and left exposed to the air for twenty-four hours. No infection resulted. Simond strongly favors the view that the flea is the principal direct agent of infection. Rats in freedom when ill with plague become covered with fleas. These remain in the hair for several hours after the death of the animal, and it has been found that contagion from handling a dead rat occurs only when the rat has been dead but a few hours. A man who contracts plague by seizing a dead rat develops inguinal buboes usually and not those of the axilla. The flea found on rats in India is of medium size and gray in color, and when placed on dogs or on a man it attacks them immediately. Fleas are rarely present on rats kept in laboratories, and this may explain the impunity with which these animals are handled when dead of plague. Yersin has shown that the bacillus of plague can grow in the intestine of the fly, and the same may be true of the flea. [Nuttall thoroughly studied the effects of the bacillus pestis when fed to flies.¹ Ogata² and the German Commission³ recognized the possibility of infection by fleas, but Simond is the first to study the subject at all thoroughly.]

Simond examined the intestinal contents of fleas taken from rats stricken with plague, and in several instances found an organism morphologically like the plague bacillus. These were never found in fleas from healthy rats. He inoculated three mice with the bodies of fleas from a plague-stricken rat. One died in eighty hours of plague. The other two died nine and twelve days later, but no bacilli were found in them.

Healthy rats were placed with rats which had died of plague, but free from fleas, and in no case did infection occur. When, however, a healthy rat was placed in a double cage separated by a wire partition from a rat dead of plague, and covered with fleas, he died of plague in five days.

In about one in twenty cases of plague, one or more vesicles are found

¹ *Centralbl. f. Bacteriologie*, xxii. 87.

² *Ibid.*, xxi. 775.

³ *Deutsche med. Wochenschrift*, xxiii. 501.

at the beginning, containing a fluid at first clear but later sanguineous or purulent, and invariably the plague bacillus, at first in pure culture but later in association with other organisms. These vesicles occur where the skin is delicate. A bubo always develops at the base of the limb. They probably mark the point of infection.

Simond admits that the flea theory is not absolutely proven, but it explains many obscure facts. It remains to be shown how long the bacillus can live in the flea, and whether it increases or diminishes in virulence while there. The theory explains contagion by clothes, predilection of plague for dirty houses and the lowest classes of the inhabitants, and the freedom of European hospital attendants.

Bandi and Balistreri¹ worked on experimental infection by the digestive canal. Forty-seven guinea-pigs were repeatedly fed on cultures twenty-four hours old, and on blood and organs of animals dead of plague. All finally died after an illness which was usually chronic, some living as long as forty-five days. These results were not due to toxins swallowed, as cultures heated to 58° C. for one hour did not kill the animals even when inoculated subcutaneously or intraperitoneally. The mesenteric glands and Peyer's patches were enlarged. The bacilli were evidently taken up by the lymphatic structures, and did not appear in the blood except just before death. In the more chronic cases nodes appeared in the spleen, liver, and lungs. Pneumonia developed in a few of the cases.

L. F. Childe,² in a careful study, found that the mesenteric glands are not enlarged in cases of plague in man. This would strongly argue against the alimentary canal as being the usual seat of infection. He found the initial vesicle in four cases, the corresponding lymph-gland being always affected. In plague pneumonias no path of infection was found, but, as the growth of the bacillus was mainly in the lungs, its mode of entrance was probably through the respiratory tract. As hemorrhages occur in all mucous membranes, the bacilli may escape from the kidneys, stomach, intestines, or lungs.

Koch³ was able to infect rats through the uninjured mucous membrane of the nose and conjunctiva. He also infected rats and monkeys by feeding them on large quantities of cultures, producing a hemorrhagic infiltration of the stomach and intestine.

Kobler⁴ finds that the conclusions of the Venice Convention remain unshaken in spite of the important work that has been done since then. Infection may be carried by wearing apparel, rats, mice, hogs, flies, fleas, and ants. The bacillus is readily killed by drying, and lives in water

¹ *Zeitschrift f. Hygiene*, xxviii, 261.

² *British Medical Journal*, 1898, ii, 858.

³ *Reise Berichte*.

⁴ *Wiener medicinische Wochenschrift*, xlviii, 894, 960.

but a short time. Hunger and bad surroundings predispose to infection. There is but slight danger of an extensive epidemic outside of Asia.

Yokote¹ determined the duration of life of the bacillus in the buried body. Mice dead of plague were enclosed in wooden boxes and buried in garden-earth which was kept moist. They were dug up after varying lengths of time. Bacilli were never found in the earth, and they had always disappeared from the bodies inside of from twenty to thirty days, and in even a shorter time in warm weather when saprophytes flourished.

Kitasato and Nakagawa make a valuable contribution to the subject of plague in the *Twentieth Century Practice of Medicine*, vol. xv. Kitasato notes the discrepancies between Yersin's description of the bacillus and his own. Kitasato's bacillus is mobile, stains by Gram, and coagulates milk, differing in these respects from Yersin's bacillus.

To state briefly our present knowledge of the manner of infection, we can say that in the vast majority of cases infection is through the skin, the flea being, probably, the direct agent; that the pneumonic cases are almost certainly the result of inhalation, and that the digestive tract is a possible but unusual port of entry.

Symptoms. George Sticker² gives an excellent account of the symptoms of plague as observed at Bombay. Several clinical types occur. The onset is sudden, with rapidly increasing weakness, clouding of senses, unconsciousness, and paralysis of the arterial system. Local appearances may be insignificant. The most frequent and characteristic localization of the bacilli is in the glands, and has given the disease its name. Painful, quickly or slowly growing swellings appear in the inguinal, axillary, cervical, or other glands, exceptionally several regions being affected at once. Fever begins acutely and is continuous or remittent, and severe headache develops. The pulse is extremely frequent, elastic, and dicrotic at first, but it soon becomes soft. The illness reaches its height on the first day or, more seldom, on the second or third, death in 50 per cent. to 90 per cent. of the cases occurring between the third and fifth days inclusive.

Any of the lymphatic glands may be the first to be inflamed, glands of the first order often appearing to be passed over, while glands of the second or third order are affected. Whole chains of peripheral glands acutely inflamed, with œdema of surrounding tissue, may cause tumors as large as the fist.

In not a few cases a pustule or furuncle in the skin is the first appearance, the nearest gland being swollen, and the two connected by lines of lymphangitis. Later numerous pustules and vesicles appear along the

¹ Centralblatt f. Bacteriologie, xxiii. 1030.

² Münchener med. Wochenschrift, xlv. 11.

line, the bubo itself becoming a huge carbuncle. The primary pustule is usually on the extremities, but sometimes about the umbilicus, in the gluteal region, or on the prepuce. If death does not occur the glands suppurate or are slowly absorbed.

Evidences of severe gastro-intestinal irritation appear, such as uncontrollable vomiting, and there may be hemorrhages from the mucous membranes, as shown by black stools, bloody urine, and bleeding from the female genitalia. Bleeding into the skin, which in old epidemics was considered to be pathognomonic and gave rise to the name "Black Death," was rare in Bombay, and when present was in small amount.

A second clinical form of plague is characterized by pustules in the skin, like those occurring at the initial lesion in the bubonic form. A small, brown spot appears anywhere, having a hot, stinging or itching sensation, while the skin in the neighborhood is red and burning. A vesicle develops, having cloudy fluid contents, which grows to the size of a hazelnut and finally forms a black ulcer with a dry base, which may be surrounded by an area of necrosis. The general symptoms are milder than in the bubonic form, but secondary bubo formation or septicaemia may develop.

The third clinical form is the plague pneumonia. It begins with a chill, followed by fever, and râles are heard over one or more lobes. The usual picture is of a catarrhal pneumonia, with abundant fluid mucous sputum, white or reddish, which contains numerous plague bacilli. There is severe depression or delirium, and death usually occurs on the third day. In other cases the type is lobar, with dullness over an upper or a lower lobe, and with tenacious yellow or rusty sputum, containing the plague bacillus alone, or with the pneumococcus, streptococcus, or the influenza bacillus. There may really be a primary diplococcus pneumonia, with secondary invasion by the plague bacillus. In two cases there was in the centre of a lobe a hemorrhagic necrosis which, had life continued, might have developed in a few hours into the gangrene with profuse hæmoptysis, which occurred so frequently in the Black Death. A chronic pneumonia occurs. Fresh or healed tuberculous nodes seem to form a favorable seat for the growth of the plague bacillus. Increase of mortality from tuberculosis during a plague epidemic was noted of old, and recent Bombay statistics show the same. Pneumonic plague is invariably fatal. In the present epidemic it is not nearly so frequent as in the earlier ones.

Profuse hemorrhage and gangrene of the lungs have not been noted in the Bombay epidemic, nor has gangrene of the nose, lips, or feet.

The existence of an intestinal form of plague has been denied by many, but in other epidemics it is distinctly described, clinically and anatomically, and the German Commission has produced it experi-

mentally by feeding infected material to rats and monkeys. The symptoms resemble intestinal anthrax or an extremely acute typhoid fever. Carbuncles have been found in the gastric mucous membrane.

In all these forms the bacilli may reach the blood and produce a general sepsis with acute spleen tumor and death in a few hours or days. A primary septicemia without local lesions is usually described, but it probably does not exist. Many cases in which no local lesion was found clinically came to autopsy by the German and Austrian Commission, and invariably the section revealed some hemorrhagic glandular or pulmonary focus which was the primary seat of disease.

General sepsis may give rise to a secondary meningitis, emboli in liver or kidneys, cholecystitis, and pericholecystitis.

Septico-pyæmia may occur with purulent metastases, due to a mixed infection with streptococci.

Suppuration in buboes is always a result of mixed infection with pus-forming organisms. Streptococci or staphylococci are regularly found in the suppurating glands, but puriform liquefaction of buboes may occur without the presence of organisms, a distinction which has not hitherto been made.

During the epidemic many cases came to the hospital with early symptoms of plague, which, however, recovered in a few days. Most of these were purely hysterical, but two cases developed after effects of plague—soft arteries with frequent pulse, deafness, and paralysis of the palate.

Diagnosis. Sticker¹ found that agglutination is not of much value in the diagnosis of plague, as it occurs only in outspoken cases. It was absent in abortive cases and in cases where the disease remained localized in a single skin pustule in which the bacillus was found nevertheless. It does not appear in the first days, but is seen fairly well at the end of the first week in dilutions of 1 to 8 or 1 to 10, in the third week in dilutions of 1 to 25, and in the fourth week in dilutions of 1 to 50.

The important points in diagnosis are the sudden onset, the staggering gait, great weakness, frequent pulse of low tension with filled artery, injection of conjunctivæ, and a tongue having the color of mother-of-pearl, or appearing as though plastered with lime. Conditions from which plague must be distinguished are ordinary pneumonia, pernicious malarial fever, typhoid fever, and anthrax.

The bacilli are found in pneumonic cases in the sputum, and in septic cases in the blood, urine, and by spleen puncture. They can be demonstrated in the skin pustules. Puncture of a bubo is a dangerous procedure, and is never necessary for diagnosis. In the suppurating bubo the

¹ Loc. cit.

bacilli are only exceptionally found. After death the bacilli rapidly disappear, as was shown by several cases in which they were found in the blood during life, but could not be demonstrated at the autopsy. They are often found in fresh tissue, but not in sections of the same tissue when hardened and preserved.

The sequelæ are of use in making a diagnosis after recovery. Injection of sterilized cultures is not of value for this purpose, as even after severe attacks the reaction is the same as in healthy individuals who have not had plague.

Sequelæ and Complications. Sticker¹ sums up the after-effects of plague as follows: Continuing paralysis of the cardio-inhibitory action of the vagus, vasomotor paralysis, paralysis of one or both sides of the palate, aphonia, aphasia, hysterical muteness, monoplegias, paraplegia, incomplete hemiplegia, amauroses, and deafness of central origin. A very common complication is parenchymatous keratitis, leading usually to iridocyclitis, and not infrequently to panophthalmitis, both eyes being affected more often than one. This is a secondary infection following necrosis caused by the toxin, and not due to drying of the cornea as in cholera, for it may occur early in the disease and not especially in association with severe depression. A chronic tuberculosis usually becomes acute, owing, probably, to lowered powers of resistance.

Treatment. Since the discovery of the bacillus, studies in artificial immunity have led to the introduction of protective inoculations based on the production of active or passive immunity. Haffkine's method, which belongs to the former class, is prophylactic, resembling his cholera-inoculation. He injects cultures of the bacillus which have been sterilized by heat at 58° C. for one hour, a temperature which effectually kills the bacilli without seriously damaging the toxins. Experiments on animals having shown this method to be effectual in protecting against infection, it has been used extensively in human beings, and the results carefully noted. Haffkine and Bannerman² reported recent statistics to the British Medical Association. In general, those inoculated show a diminished susceptibility, and when infected the disease runs, in them, a mild course which seldom ends fatally. In each village or institution experimented upon, about one-half of the inhabitants or inmates were inoculated. At Byculla Prison, of 173 not inoculated 12 took the disease, of whom 6 died; of 148 inoculated 2 took the disease and none died. At Lower Damaon, of 6033 not inoculated 1482 died; while of 2197 inoculated 36 died. If the same proportion had died as among the uninoculated there would have been 332 deaths, instead of 36; in other words, there was a reduction in mortality of 89.2 per cent.

¹ Loc. cit.

² British Medical Journal, 1898, ii, 853.

At Lamowli 337 people not inoculated showed 78 cases and 58 deaths, while 233 inoculated showed 14 cases and 7 deaths, a reduction of 85.7 per cent..

At Kirkee, 859 not inoculated had 143 cases and 98 deaths, and 671 inoculated had 32 cases and 17 deaths, a reduction of 77.9 per cent.

At a jail in Bombay, 10 cases with 6 deaths occurred among 127 not inoculated, while but 3 cases with no deaths occurred among 147 inoculated. Among the members of the Khoja Mussulman Company in Bombay, 3 died of 3814 inoculated, while of 9516 not inoculated, 118 died of all causes, showing a reduction of 86 per cent.

Haffkine¹ also reports results obtained at Undhera in February and March, 1898, when 27 cases with 26 deaths occurred among 437 of the inhabitants not inoculated, and 8 cases with 3 deaths among 513 who submitted to the operation, one-half of the men, women, and children in each household being inoculated. The epidemic continued for forty-two days after the inoculations were made.

The most recent statistics are from the town of Dharwar,² where 1118 cases with 879 deaths occurred among 3089 individuals not inoculated, and 106 cases and 37 deaths among 3074 inoculated once, while only 17 cases and 4 deaths are recorded among 3557 who were twice inoculated.

Koch³ found that Haffkine's method was of undoubted value, and, while not protecting absolutely, the cases which developed after inoculation were usually mild.

It is especially of value in small communities and for physicians, attendants, and the disinfecting staff. The immunizing material being in the bodies of the bacteria, and but little going into the fluid, it is best to use young cultures in which the bacilli are numerous.

R. Harvey, Surgeon-Major-General,⁴ finds the inoculations of great value, and thinks that, as an inducement to the people to submit to the operation, those inoculated might be freed from some disagreeable quarantine restrictions.

At a meeting of the Bombay Medical Union,⁵ a society composed of native Indian physicians, held in November, a resolution was passed declaring it to be the opinion of the society that Haffkine's prophylactic is a reliable safeguard against the plague; that the immunity lasts six months at least; that a second inoculation ten days after the first is desirable; that no evil effects follow, and that no diseases, such as leprosy or syphilis, are introduced, nor are existing diseases aggravated.

The method of Yersin is inoculation with the serum of horses which

¹ Indian Lancet, xi. 545.

² Lancet, 1898, ii. 1806.

³ Reise Berichte, Berlin, 1898.

⁴ Indian Lancet, xi. 537.

⁵ Lancet, 1898, ii. 1806.

have been rendered immune by the injection into their veins of living virulent cultures of the bacillus.

The first experiments on patients at Canton were very satisfactory, the mortality being only 7.6 per cent., but at Bombay the mortality was 40 per cent. in spite of the fact that obviously hopeless cases were not treated. Lately a stronger serum has been produced, with which the results are said to be promising.

With this later serum Koch¹ was able to immunize the brown monkey by injecting 3 c.c. Immunity was perfect after four days, weak after eight days, and had entirely disappeared at twelve days. When the serum was injected immediately after the bacilli, the animal showed slight symptoms. When injected six, twelve, or twenty-four hours later, the animal became very ill, but recovered; but if forty-eight hours were allowed to pass before injection of the serum, it had no appreciable effect.

Ten c.c. of the serum failed to immunize the gray monkey, a species extremely susceptible to the disease. Koch finds the value of the serum in man still doubtful.

Diendonné² notes that after the injection of the serum there is almost always an improvement in the heart's action, and sometimes a fall of temperature. It has undoubted curative properties, but so large an animal as man would require enormous doses to produce the effects seen in monkeys. In one village two-thirds of the men received injections as prophylactic, and no cases occurred among them, while there were numerous cases among the rest of the inhabitants. In another plague district, 500 individuals received injections, and 5 cases with 2 deaths occurred among them.

A prophylactic has been prepared by Lustig and Galeotti by dissolving the bacilli in caustic potash and precipitating by means of weak acetic acid. Results by this method have not been satisfactory.³

Recent experience has thus shown the Haffkine prophylactic to be an agent of undoubted therapeutic value.

Yersin's antitoxic serum has been shown by animal experiment to be efficacious in all animals except the very susceptible gray monkey. At present its value in the treatment of plague in human beings is still in doubt, but we may hope that in time a serum of greater potency will be produced which will lower the present high mortality of the disease.

Topschieff⁴ studied the influence of temperature on the bacillus pestis. Observers are not in complete agreement as to the height of temperature and length of exposure necessary for killing the bacillus. Accurate determination of this is important for disinfection and in making the Yersin and Haffkine serums. Heretofore heat at 58° C. for one hour

¹ Reise Berichte.

² Münchener medicinische Wochenschrift, xlv. 166.

³ Lancet, 1898, ii. 1806.

⁴ Centralblatt f. Bacteriologie, xxiii. 730.

has been employed, but the experiments of Toposchieff show that heat at 54° C. for thirty minutes destroys the bacilli, and that cultures so sterilized are better for producing immunity than those heated higher and for a longer time. He found that bacilli grown on media for a long time decrease in virulence, but that mice inoculated with such cultures acquire an active immunity to fully virulent cultures. [This is contrary to the experience of Koch.] He found that heating to temperatures not high enough to kill causes the bacilli to grow more slowly than normally, but does not cause them to lose in virulence.

Simond¹ recommends that prophylactic measures be taken against (1) rats, (2) parasites, (3) and men. Ships arriving and ships departing should be fumigated with vapors of sulphurous acid, formol, or some other vapor, to asphyxiate the rats. Boiling water should be thrown on dead rats before their removal. Boiling water should be thrown on floors. Clothes should be destroyed or heated to 70° C. for several hours, and rooms should be fumigated.

Nadeschda Schultz² made a series of experiments in disinfection of objects and rooms. The tests were made on bouillon cultures and strips of Swedish filter-paper saturated with emulsions of the bacilli. The following chemicals were tried in various concentrations and for varying lengths of time: Corrosive sublimate, corrosive sublimate and hydrochloric acid, phenol, parachlorphenol, formalin, lime, green soap, caustic soda, and sulphuric acid. For disinfection of objects, sublimate and hydrochloric acid proved better than sublimate alone, and parachlorphenol was four times as efficacious as phenol. Formalin had but feeble action, and green soap acted only at a high temperature (50° C.). For rooms formalin, by the apparatus of Trillat, was best, but nothing proved to be penetrating.

Schultz found spore formation, in opposition to all other observers.

The Indian Government has spared no expense in trying to combat the plague. K. Marion Hunter³ has given an account of the methods employed at Poona, a city of 130,000 inhabitants, and they do not differ from those in other towns. Great efforts were made to have each case removed to a hospital, and all who were in contact with the case were kept at a "Segregation Camp" for ten days, the houses meanwhile being disinfected. The greatest difficulty was experienced in finding the cases, and large numbers escaped detection. When the epidemic was at its worst the aid of the military was called in, the city being divided into ten districts, each in charge of an officer and a doctor, with soldiers and native helpers under them. Search from house to house was made, and finally a cordon system was adopted, the soldiers completely cutting off

¹ *Annales de l'Institut Pasteur*, xii. 625.

² *Centralblatt f. Bacteriologie*, xxiii. 591.

³ *Nineteenth Century*, xlviii. 1008.

the region in which the inspection was being made. Strict quarantine was maintained at the segregation camp, but there was also established a health camp for inhabitants of unsanitary but non-infected houses, where the regulations were not so severe, the inmates being allowed to go to work. There was a detention camp, where travellers on the railways were held for observation. There were several small caste hospitals and a general plague hospital or camp. This latter was made up of a series of matting sheds with roofs of corrugated iron covered with straw, and having walls which could be opened, as the upper four feet was a matting shutter. The staff was three English doctors (two men and one woman), a native medical officer, twelve hospital assistants, and fifteen English nurses.

Nield Cook¹ comments on the regulations. Notification, isolation, and disinfection are attempted, but notification is impossible, as the people effectually conceal the cases, and even search parties do not succeed. Segregation, therefore, is imperfect, Cook estimating that there were 23,010 "contacts" at Wari Bundar, while only 1572 were in the segregation camp. The religious scruples of the people interfere with the killing of the rats. The good-will of the people is absolutely necessary, and the castes must be kept separate in camp and hospital.

H. P. Dimmock² found the system of segregation camps efficient in the smaller towns, complete evacuation of the infected quarter being the best plan. He finds the outlook grave, owing to the habits of the people.

The opposition of the people to the removal of patients to the hospitals resulted in a riot at Bombay³ in March, 1898, in which several persons were killed. The Government then modified the regulations, abolishing the search parties, inspection of dead, and removal of hopeless cases without permission of relatives. Compensation is to be given at once for destruction of property belonging to the poor. The railway detention camps are abolished.

The statistics of Mr. Baldwin Latham show that the plague in London lasted continuously from 1603 to 1680—seventy-seven years—and it is now generally admitted that the plague cannot be suddenly stamped out in India. It has come to stay for a long time, and, this being the case, the present elaborate and expensive methods cannot be kept up, because the Government cannot keep up the heavy expense indefinitely, and because the interference with trade and the bread-winning of the inhabitants for a long time is impossible.

The Government has decided that by attempting less it may accomplish more.

The British Government has sent a special commission to India to

¹ Indian Lancet, xi. 479.

² British Medical Journal, 1898, ii. p. 858.

³ Lancet, i. 1040.

inquire into the plague, especially as to (1) the origin of outbreaks, (2) communication, and (3) prophylactic and other serums. Drs. T. R. Frazer, M. A. Ruffer, and A. E. Wright have been appointed on this commission.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.

Etiology and Manner of Infection. One of the most notable communications ever made on this subject is the monograph of Councilman, Mallory, and Wright,¹ in which an exhaustive study is made of 111 cases which occurred during an epidemic in Boston. In 1887 Weichselbaum described the diplococcus intracellularis meningitidis, which he found in six cases of cerebro-spinal meningitis, but the pneumococcus was still generally held to be the causative agent in this disease. In 1895 Jäger found Weichselbaum's diplococcus in twelve cases, and in 1896 Heubner found it in nine. In the Boston epidemic it was demonstrated in all but four of thirty-five cases examined post mortem, and there is now no reason to doubt that it is the cause of the disease. The wide-spread view that the pneumococcus is the cause is due to the fact that a pneumococcus meningitis is frequently met with as a complication of lobar pneumonia. The diplococcus intracellularis resembles the gonococcus, as it has the coffee-bean appearance, occurs in the polymuclear leucocytes, and decolorizes by Gram; but it differs from the gonococcus in the fact that it grows on blood-serum, agar, and other media. It grows best on the Loeffler blood-serum, but its growth is seldom vigorous on any medium. Often it may be found in the smears from infected material, but not in cultures from the same material, and in several cases, where the organisms were numerous on the cover-slips, only one or two of ten culture tubes showed a growth. Separate colonies always developed, even when large quantities of material were used. The organism was found to be non-virulent to animals when injected subcutaneously, but when it was injected into the peritoneal or pleural cavities a small number of the animals succumbed. Typical meningitis was produced only in a goat after the inoculation of 1 c.c. of a suspension of a blood-serum culture into the spinal canal. To keep the cultures going they had to be transferred daily to four or five tubes, and on some of these there was usually no growth.

Weigert believes that infection takes place through the nasal mucous membrane, and other observers have reported coryza as occurring at the beginning of the attack, but it is recorded in only one of Council-

¹ Report of Massachusetts Board of Health, 1898; also the American Journal of the Medical Sciences, cxv, 251; Philadelphia Medical Journal, i, 937; Johns Hopkins Hospital Bulletin, ix, 27; Journ. Boston Soc. Med. Sci., ii, 53.

man's cases. The nasal secretion was examined in nineteen cases, and in ten of them an organism morphologically like the diplococcus intracellularis was found, sometimes free, but often in pus cells. However, a similar organism was found in the nasal cavities of two of twelve individuals not having meningitis. None of these could be cultivated, owing, probably, to the large number of other organisms present. Councilman points out that it is just as probable that the nasal infection is secondary to the meningeal as *vice versa*.

Gwyn¹ succeeded in demonstrating for the first time a general infection by the diplococcus of Weichselbaum in a well-marked case, with involvement of several joints and a purpuric eruption, which was admitted to the Johns Hopkins Hospital. The typical organisms were found in the spinal fluid, in the blood, and in the joint effusion during life. At the autopsy the organisms were found only in the lesions of the brain and spinal cord, and it is possible, as Councilman says, that they may be present in the blood, spleen, liver, and kidneys, and not grow in the cultures. It is to be hoped that blood cultures will be made during life in other cases showing indications of general infection, such as purpura, joint effusions, and pneumonia. Ten c.c. of blood should be drawn from a vein into a sterile syringe and inoculated on Loeffler blood-serum. It is probable that in this way general infection will be shown to be of not infrequent occurrence.

Osler² reports seven cases which occurred in Baltimore during the spring of 1898. Lumbar puncture was performed in five cases, in three of which the diplococcus intracellularis was found.

A small epidemic occurred at Paris. Netter³ reports twelve autopsies in which he demonstrated an organism corresponding to Weichselbaum's diplococcus, except that he found it took Gram's stain and grew in long chains in bouillon. It was associated with tubercle bacillus in three cases. He holds strongly to the view that the meningococcus is a degenerate form of the pneumococcus, as stated by him previously.

Stewart and Martin⁴ report a case of cerebro-spinal meningitis in which the diplococcus intracellularis was found at autopsy in the meninges and in a purulent pericardial exudate. Cultures from blood, liver, spleen, and bile were negative. They found the organisms both free and in the pus cells. This appears to be a genuine sporadic case caused by the diplococcus intracellularis.

Meyer⁵ reports a case in which both the diplococcus intracellularis

¹ Philadelphia Medical Journal, ii. 1255.

² Maryland Medical Journal, xxxix. 717.

³ Bulletin et Mém. Soc. Méd. des Hôpitaux de Paris, xv. 407 and 434.

⁴ Montreal Medical Journal, xxvii. 159.

⁵ Münchener med. Wochenschrift, xlv. 1111.

and the pneumococcus were isolated from the meninges at autopsy. The lungs showed a bronchitis.

Symptoms. Wentworth,¹ from a study of the Boston epidemic, finds that the disease varies, not in the presence or absence of certain symptoms, but in differences in their intensity and in the period at which they appear. Symptoms which are almost constant are headache, pain in the neck and spine, retraction or rigidity of the head, and some degree of mental disturbance. Other symptoms not so constant are vomiting, hyperaesthesia, herpes, changes in the pupils, and conjunctivitis. Moderate and irregular fever, bearing no relation to the severity of other symptoms, is characteristic of the disease. The onset is almost always sudden, with headache, fever, and sometimes a chill. Vomiting and convulsions at the beginning are seen especially often in children. Petechiae and ecchymoses occur oftenest in the more severe cases. The pulse is slow in a large proportion of adults, but rapid in children.

Williams² gives an interesting tabular statement of the seventy-one cases at the Boston City Hospital. When leucocyte counts were made more than once, the later counts were greater than the earlier in the fatal cases, while in nearly all the cases that recovered there was a decrease in the later counts. In Osler's seven cases the leucocytes varied from 13,000 to 45,000, the highest counts being in the fatal cases.

Diagnosis. Quinke's lumbar puncture has come to be regarded as of the greatest importance in the diagnosis of this disease. In numerous trials made of late it has proved harmless, and Williams thinks it is sometimes even of therapeutic value. The technique, as quoted by Councilman from Wentworth, is as follows: All antiseptic precautions are to be taken. The patient should be placed on the right side, with the knees drawn up and with the uppermost shoulder so depressed as to present the spinal column to the operator. An antitoxin needle, 4 cm. long and 1 mm. in diameter, is well adapted for children, but a longer needle is needed for adults. Williams recommends a trocar. The puncture is made between the third and fourth lumbar vertebrae, or between the second and third. The thumb of the left hand is pressed between the spinous processes, and the point of the needle is inserted about 1 cm. to the right of the median line and on a level with the thumb-nail, directed slightly upward and inward toward the median line. Care must be taken to prevent the needle from passing to the left of the median line and to prevent its striking the bone. At 3 or 4 cm. in children and at 7 or 8 cm. in adults the needle enters the sub-arachnoid space and the fluid flows by drops, aspiration not being necessary. If bone is met with the needle should be somewhat withdrawn and

¹ *Lancet*, 1898, ii. 854.

² *Medical and Surgical Reports of Boston City Hospital*, ix. 106.

thrust in again, directing it toward the median line, lateral movements not being made on account of the danger of breaking the needle or of causing hemorrhage. The fluid is received into a sterile test-tube. Cover-slip smears and cultures on Loeffler blood-serum with several cubic centimetres of the fluid are made. When present in small number the diplococci may be missed on the cover-slips, and even when present in large number on the cover-slips the culture tubes may show only one or two colonies. Lumbar puncture was made in 55 of Councilman's cases, and diplococci were demonstrated in 38 of them. They are most constantly present early in the disease, when diagnosis is difficult from the symptoms alone. It is hoped that lumbar puncture with careful bacteriological examination of the fluid will be made in the sporadic cases which are constantly occurring, as in this way it may be determined whether or not these cases are due to the *diplococcus intracellularis*—a point at present obscure. The demonstration of the organism is of importance for prognosis, as only the *diplococcus* cases ever recover, and in the future it may be of importance for treatment.

Netter¹ finds the sign of Kernig of great value in diagnosis. It consists in the impossibility of obtaining complete flexion of the knee when the patient is in the sitting posture, while it can be done perfectly when the patient is recumbent. This sign appears only in meningitis, and has led to a correct diagnosis of meningitis complicating typhoid fever, which would not otherwise have been made. It may disappear early or persist into convalescence. It does not occur in tubercular meningitis.

The presence of diplococci in the nasal secretion has no diagnostic value, as Councilman has shown that such organisms may be found in individuals not having meningitis.

Sequelæ and Complications. Osler² reports two cases with joint involvement, in one of which the *diplococcus intracellularis* was demonstrated in the joint effusion, as well as in the spinal fluid and in the blood. In the other case the inflammation of the joints occurred at the beginning and had subsided before meningeal symptoms appeared. The joint affections which complicate various acute and chronic diseases of the spinal cord have been generally regarded as trophic in character. The demonstration of the specific organism in the blood and joints shows that the arthritis may be the effect of a general septicæmia in this disease at least. Careful bacteriological study of the joint complications in all infectious and nervous diseases is to be desired.

In seven of Councilman's cases there was pneumonia due to the *diplococcus intracellularis*, and in two there was croupous pneumonia

¹ Bull. et Mém. Soc. Méd. des Hôpitaux de Paris, xv. 639.

² Boston Medical and Surgical Journal, cxxxix. 641.

caused by the pneumococcus, the meningeal lesions containing the diplococci intracellularly. The erroneous belief that pneumonia is a frequent complication of epidemic cerebro-spinal meningitis is due to the frequency of pneumococcus meningitis as a complication of pneumonia.

Conjunctivitis, strabismus, nystagmus, and dilatation and inequality of the pupils are frequently noted. Councilman finds the eye lesions to be due to three causes: 1. Degeneration of the nerves of the eye due to their involvement in the exudation at the base of the brain. 2. Extension of inflammation from the meninges, which is direct and not metastatic, as held by ophthalmologists; a metastatic choroido-iritis occurs in other forms of meningitis where the meningitis itself is metastatic. 3. Most cases of keratitis are due to neuritis of the fifth nerve with destruction of the Gasserian ganglion and loss of sensation.

The ear lesions are the most common complication of cerebro-spinal meningitis. Councilman found an involvement of the auditory nerve in all cases in which it was examined. There was sometimes a purulent exudation along the nerve-sheath with more or less complete destruction and infiltration of the nerve. Otitis media occurred in five cases, in three of which the pus was examined and found to contain diplococci. Where meningitis is secondary to ear disease, the organism present is either the pneumococcus or the streptococcus.

Treatment. There is no effectual method of treatment. Counter-irritation to the spine, as Wentworth says, probably does nothing but increase the discomfort of the patient. The application of the ice-bag to the head is still employed, and hydrotherapy is of use in hyperpyrexia. Morphine may be needed for the pain.

Stimulation and feeding are of importance, especially in the chronic cases, the use of the stomach-tube being sometimes necessary.

Recent researches have served to clear up the bacteriology of this disease, and have given us a certain method of diagnosis in lumbar puncture, and it is possible that further studies may lead to the production of a curative serum.

PNEUMONIA.

Etiology. **ATMOSPHERIC CONDITIONS.** Brunner¹ has made a study of the atmospheric and cosmic conditions in relation to the origin of croupous pneumonia. From a consideration of 2140 cases he concludes, among other things, that the chill usually occurs toward evening or in the morning; that the outbreak of the disease has often an undeniable relation to changes in the weather. It is favored, he thinks, when, after

¹ Deutsche Arch. f. klin. Med., 1898, lx. 339.

a period of cold weather, with falling barometer and much moisture in the air, there follows a rise in temperature, south winds, and snow or rain.

ASPIRATION PNEUMONIA. Stubenrath,¹ as a result of experiments with animals upon the production of aspiration pneumonia, concludes that the pneumonia is dependent upon the mechanical influences of aspiration, occurring without regard to what fluid is used.

TRAUMATIC PNEUMONIA. Bloch² reports a case of pneumonia following a contusion of the chest, and concludes that trauma predisposes toward the disease by causing a mechanical injury to the lung. The pneumococci, which normally are inhabitants of the upper air-passages, find here a suitable nidus for development.

Padoa³ comes to the same conclusion as to the mechanism of trauma in causing the disease.

Symptoms. "PNEUMONITIS METAPLEURICA." Baccelli,⁴ in a lecture upon croupous pneumonia, calls attention to a variety of the disease occurring secondarily to a pleurisy; he has seen a number of instances of this condition, which he terms "pneumonitis metapleurica." During the first day the patient shows signs of an intense pleurisy. On the fourth or fifth day evidence begins to appear of an acute pulmonary œdema with grave symptoms—dyspnoea and serous sputum which becomes slightly tinged with red and sometimes truly hemorrhagic though not viscous. The pneumonia pursues a rapid course, reaching a stage of gray hepatization early. All Baccelli's earlier patients died, but when he began to treat his cases from the beginning of the pleurisy with repeated wet cupping the mortality was materially less. An epidemic of this nature occurred under the same physician's observation some years ago, before accurate methods of bacteriological study were in vogue.

THE URINE. Pick⁵ makes an interesting note upon the urine in pneumonia. He finds that from twenty-four to forty-eight hours after the critical defervescence the urine, which has previously been strongly acid, becomes neutral or even alkaline. This phenomenon, which was observed in 31 out of 38 cases, persists for one or two days; the urine then becomes acid. The condition, he believes, is due to the absorption of the exudate which contains large quantities of sodium salts.

Jacob, of Berlin, in the discussion suggested that it might be explained by the sudden enormous destruction of leucocytes which occurs during the crisis.

HYPERPYREXIA. Ironside⁶ reports a case of pneumonia with hyper-

¹ Ueber Aspirationspneumonie, insbesondere nach Eindringen von Ertrankungsflüssigkeit u. neber ihre gerichtsarztliche Bedeutung. Würzburg, 1898. A. Stuber's Verlag.

² Muench. med. Wochenschrift, 1898, No. 30.

³ La Riforma medica, 1898, Ann. xiv. t. iii. 473.

⁴ Ibid., xiv. t. ii. 233.

⁵ Verhandl. d. XVI. Cong. f. inn. Med., 1898, 507.

⁶ British Medical Journal, 1898, i. 1258.

pyrexia in a man of twenty-eight years. The highest temperatures were 109.5° F. on the fourteenth day, and 109° F. on the seventh day.

TRAUMATIC PNEUMONIA. Padoa,¹ in his above-mentioned study of traumatic pneumonia, concludes that there is nothing in the course of the disease which enables one to separate it from lobar pneumonia of the ordinary sort.

SUDDEN DEATH. La Fournier² discusses sudden death in pneumonia. This is commonest during the stage of gray hepatization; neither the seat nor the extent of the pneumonia, nor the gravity of the case seems to have any special influence upon the development of this distressing complication. Undue physical effort is the commonest cause. The mechanism is obscure.

APYRETIC PNEUMONIA. Guider,³ in a thesis upon apyretic pneumonia, concludes that the absence of fever is attributable to the exhaustion of the economy, to functional disturbance of the nervous system, and to the action of the infective agents.

STREPTOCOCCUS INFECTION. Denny⁴ discusses the character of pneumonias in which there is an infection with streptococci. These infections are remarkable for their tendency to wander, the frequency of affection of the upper lobe, the atypical fever-curve and delayed resolution. It is important to examine the sputa, which will often reveal the streptococcus infection.

DELIRIUM. Maragliano,⁵ in a communication upon the delirium in acute pneumonia, concludes that it depends upon two factors: pneumonic infection, which determines the immediate outbreak of the delirium, and modifications in the organism of the patient, which act as predisposing conditions. Its prognostic significance is not great. The disease runs its course independently of the delirium, which may, however, be of grave import if it lasts long. As an example of this possibility he mentions the case of a woman of hysterical tendency whose delirium lasted about twelve days after defervescence, the patient dying finally of exhaustion.

ABSENCE OF LEUCOCYTOSIS. Stockton⁶ reports a case of lobar pneumonia with two relapses occurring in a little girl. During the first relapse the leucocytes were only 4000 to the cubic millimetre. The case seems to the reviewer to be of particular interest in view of the infrequency with which we find a subnormal number of leucocytes in pneumonia with favorable issue.

PNEUMONIA IN CHILDREN. West⁷ would reserve the term broncho-

¹ Loc. cit.

² Thèse de Paris, 1897-1898.

³ Thèse de Paris, 1897.

⁴ Boston Medical and Surgical Journal, 1898, cxxxviii. 341.

⁵ La Riforma medica, 1898, Ann. xiv. t. ii. 728.

⁶ Philadelphia Medical Journal, 1898, i. 1201.

⁷ British Medical Journal, 1898, i. 1375.

pneumonia exclusively for those inflammatory conditions of the lung which are of secondary nature, following previous disease of the air-passages—mainly streptococcus infections. Primary broncho-pneumonias in children are always anatomically croupous pneumonias and depend invariably on pneumococcus infection. The two forms differ markedly in their course. The pneumococcus inflammation is almost as frequent in children as in adults, but differs in its clinical manifestations. In adults one or more lobes are usually affected throughout. In children, on the other hand, there appear numerous disseminated localized foci. There is, however, no true pathogenic difference between lobar pneumonia in the adult and primary lobular pneumonia in children. The clinical differences depend, possibly, upon the special characteristics of children's lungs and respiration (paralysis of the diaphragm, elastic thorax, difference in structure of the lungs).

FAVORABLE INFLUENCE OF PNEUMONIA ON HEMORRHAGIC TENDENCY. Openschowski¹ reports a case of typhoid fever with obstinate hemorrhage from the mouth and tongue, which could not be stopped until, with the breaking out of pneumonia associated with leucocytosis, coagulation appeared spontaneously. The coagulability of the blood, he believes, was due to the increase in the leucocytes which came on in this instance with the pneumonia.

AN ATYPICAL ENDEMIC. Haedke² reports an interesting endemic of pneumonia with peculiar symptoms. Four members of one family were attacked one after another. The disease began with prostration, dyspnea, and cough without expectoration. Signs of lobar consolidation developed. The fever ran an irregular course. Three of the four cases were fatal. Streptococci were obtained from most of the organs and also a bacillus which apparently was the proteus vulgaris. The last organism was highly pathogenic for mice.

VASOMOTOR SYSTEM. Van Santvoord³ studied the condition of the vasomotor system in acute pneumonia. Cardiac failure is, he believes, usually due to vasomotor paralysis. The popular idea that the pulse in pneumonia is of high tension is in many instances erroneous. He draws the important conclusion that vaso-dilators, such as nitro-glycerin, are rarely called for. Theoretically, digitalis ought to be of use.

STATISTICS. Elsner,⁴ out of 150 cases, found that 80 per cent. showed the characteristic chill and ran a typical course ending in from six to eleven days. The right lung was involved in 60 per cent. of cases, the left in 24 per cent., and both in 16 per cent. In 12 apex pneumonias

¹ Wien. therapeut. Woch., 1898, No. 1.

² Deutsche med. Wochenschrift, 1898, xiv. 220.

³ Philadelphia Medical Journal, 1898, i. 753.

⁴ Medical News, 1898, lxxii. 33.

active delirium was not present. The initial chill was absent in only 14 per cent. of these cases in adults. In 3 cases of pneumonia in old persons the temperature never rose above 100.4°. In 4 instances active delirium occurred three to ten days after the crisis. In 3 instances there was sudden death. A leucocytosis was found in 22 out of 30 cases, while in cases examined within thirty-six hours of the crisis there was no further evidence of a leucocytosis.

A. A. Smith¹ discusses 60 cases of lobar pneumonia. In 2 instances there was complicating pleuritic effusion; in none empyema. The total mortality was 28 $\frac{1}{3}$ per cent. There were nine patients over fifty years of age, of whom only two died; 5 out of 12 cases of apex pneumonia ended fatally. Albuminuria was present in all cases in which the urine was examined with the exception of four. Cold compresses made with a padded sheet were found useful in reducing the temperature and the rapidity of the pulse, and in quieting nervous symptoms. Their effect seemed to be as good when applied to the abdomen as when applied to the chest.

Sequelæ and Complications. **ARTHRITIS.** Boix² reports a case of purulent arthritis complicating a pleuro-pneumonia in influenza from which the pneumo-bacillus of Friedländer was isolated. He quotes³ a similar case observed by Oswiecinski in the *Nouv. Lek.*, 1896.

ENDOCARDITIS. Findlay⁴ reports a case of pneumonia associated with acute tricuspid endocarditis from which the pneumococcus was isolated post mortem. No cardiac murmur was made out during life, although thrombi as large as one's thumb were found upon the valve curtains.

NEURITIS. Aldrich⁵ reports a case of pneumonia which was followed by neuritis of the brachial plexus, resulting in atrophy of the trapezius, spinati, deltoid, and supinator longus muscles. The pain in the shoulder, associated with the neuritis, was preceded by a severe attack of hiccough which came on during recovery and lasted for five days. The author believes that this was an instance of neuritis beginning in the phrenic nerve and ascending to the brachial plexus. He also reports an instance of parotitis.

ACUTE NEPHRITIS. Kleinmann⁶ reports a case of acute nephritis occurring with pneumonia, which cleared up gradually during convalescence. Pneumococci were found in the urine at the height of the process. The author believes that the changes in the kidney were due to the direct action of the pneumococci upon the renal tissue, rather than to circulating toxic substances.

¹ Medical News, 1898, lxxiii. 25.

² Arch. gén. de médecine, 1898, t. i. 605.

³ Ibid. p. 199.

⁴ Montreal Medical Journal, 1898, xxii. 350.

⁵ Medical News, lxxiii. 590.

⁶ Inaug. Diss., Berlin, 1898.

PHLEBITIS. Da Costa¹ discusses phlebitis consecutive to pneumonia. This may occur anywhere from the second to the fifteenth day after the crisis, or even later. The course is in every way like that of typhoid phlebitis. The prognosis is generally favorable, rarely, however, embolism and sudden death may occur.

MENTINGITIS. Aufrecht² reports a case of pneumonia with cerebral symptoms and empyema, which was followed two months after recovery by fatal meningitis.

MEDIASTINAL ABSCESS. Broadbent³ reports a most interesting case of pneumonia in a boy of twelve years. There was no crisis; high fever and delirium continued. Cough was so marked that chloroform had to be administered. A diagnosis of enlarged and suppurative bronchial glands was made, which was confirmed by the later course of the case. Rupture of a mediastinal abscess into a bronchus occurred ultimately, and recovery followed.

Diagnosis. Bezançon and Griffon⁴ have been able to obtain an agglutinative reaction upon pneumococci with the serum of individuals suffering from pneumococcus infections. The reaction appeared at a period varying from the third to the sixth day of the affection. This may serve as a valuable help to diagnosis in doubtful infections. They believe, however, that owing to various different types of pneumococci it may not be present in all instances.

Treatment. Pilocarpine. Rosenthal,⁵ after using pilocarpine in nine cases of pneumonia, comes to the conclusion that the drug is not only of no value, but, further, that it is sometimes actually harmful in its effects. Its use is, therefore, contraindicated.

DIURETICS. Rensner,⁶ believing that the critical sweat in pneumonia has a weakening effect on the organism, endeavored to obviate this by giving diuretics at the time of the crisis. He believes that by the use of caffeine with camphor or digitalis he has been able to diminish materially the sweating, the crisis occurring in association with marked diuresis.

USE OF COLD. Mays⁷ pleads for the more general use of cold, particularly as local applications, in the treatment of pneumonia.

Russell⁸ finds that cold baths give great relief in marked hyperpyrexia. The local application of cold is also of value in relieving pain.

¹ Philadelphia Medical Journal, 1898, ii. 519.

² Deutsche Arch. f. klin. Med., lix.

³ British Medical Journal, 1898, i. 605.

⁴ Congrès de Méd. int. de Montpellier, April 14, 1898.

⁵ Deutsche Arch. f. klin. Med., lix.

⁶ St. Pet. med. Wochenschrift, xxiii., N. F. xv., 1898, 11.

⁷ Philadelphia Medical Journal, 1898, i. 406.

⁸ Medical News, 1898, lxxii. 292.

COUNTER-IRRITATION. Stengel,¹ in cases of pneumonia with delayed resolution, advises counter-irritants, active pulmonary exercises, and mentions the fact that there is some evidence to suggest that the production of aseptic abscesses resulting in a leucocytosis may exert a favorable influence on the condition.

BLOODLETTING. Maragliano² discusses bleeding in pneumonia. Livicrato has shown that when there are limited foci of pneumonia, bleeding is followed by a diminution in the oxygen absorbed, but when the foci are extensive the oxygen absorbed and the arterial tension are considerably increased. Bleeding is particularly indicated in grave toxæmia and where there are mechanical disorders of the circulation owing to the consolidation. Toxæmia may be combated by digitalis, which antagonizes the bacterial poisons, and with De Renzi's (Panc's) serum, which neutralizes them; but when the toxæmia is marked and these means are not at hand patients should be bled, and the amount of fluid in the circulation increased by intravenous salt injections. When the circulation is disturbed bleeding is also a good remedy, and one need not be hindered from doing this because the pulse is small and irregular; according to Niemeyer, it is just in these cases that it should be employed. Bleeding, then, is an occasional and not a regular method of treatment. The quantity of blood taken at each bleeding should vary from one-fiftieth to one-tenth of the total amount.

TREATMENT OF PNEUMONIA IN CHILDREN. A discussion upon the treatment of pneumonia in children was held before the New York Academy of Medicine, which is reported in full in the *Medical News*, 1898, lxxxiii. 641-650. Only a few points can be touched upon here.

Chapin points out the fact that the temperature is not always a true indication of the degree of poisoning in the child. The best means for treating the fever, when treatment of the fever is necessary, is by the external application of cold, by ice poultices, or by applying to the chest compresses which have been dipped in water at 75° to 90°. The treatment may be employed until the temperature falls to 102° or 103° and then discontinued until it rises again. He believes that the fear and prostration incident to the giving of cold baths contraindicate them.

Holt makes an excellent communication in which he lays considerable stress upon the necessity of saving the child as far as possible from the worry excited by too much attention. His conclusions are as follows:

- "1. No depleting measures are ever admissible.
- "2. Hygienic treatment, including fresh air, proper feeding, and intelligent care, is of the utmost importance.
- "3. No unnecessary medication should be permitted.

¹ Therapeutic Gazette, 3 s. xiv. 78.

² La Riforma medica, 1898, xix. 1. iv. 811.

" 4. Many annoying symptoms may be relieved by local treatment, such as the cough by inhalations, pain by counter-irritation, restlessness by the ice-cap or sponging.

" 5. Stimulants should be deferred until demanded by the condition of the pulse.

" 6. High temperature is much more safely and effectively controlled by the use of cold than by drugs.

" 7. Greater caution is necessary in the use of powerful stimulants than is generally observed.

" 8. Rest is quite as important as in other serious diseases."

Koplik believes that baths may be more frequently used, but advises great care in their administration.

Almost all of these observers lay particular stress on *the necessity of good ventilation*, a point which the reviewer would also insist upon. The manner in which patients with respiratory affections are still shut in close, ill-ventilated, overheated apartments should be combated by every intelligent physician.

Carr, discussing the treatment of broncho-pneumonia complicating measles, lays stress also upon the same fact, advising that the patient be kept in a freely ventilated room, between 65° and 70°. In these cases he advises that the diet should be of about the same quantity as that given to a healthy child; peptonized milk, beef juice, eggs, custards, jellies, etc., are the best foods. Baths from 85° to 90° are the best antipyretics.

Barnes discusses the methods of giving baths and packs, and lays particular stress upon the necessity of employing vigorous friction throughout. Baths are not always necessary—"treat the child and not the disease."

ANTITOXIC TREATMENT. The most interesting literature in connection with pneumonia which has appeared during the last year is that relating to the treatment of the disease by antitoxic serum. Washburn obtained from an immunized pony an antipneumococcus serum which clinically has given results of a favorable but not positive nature. Professor Pane and De Renzi, of the Naples school, have prepared an antitoxic serum which they have recently put on the market. The work has been done at the Instituto Sieroterapico in Naples. They have succeeded in immunizing larger animals, and have found that the serum of these animals has preventive and curative properties. Pane¹ has collected nine cases treated during December, 1897, by this method. All but one recovered. The serum used varied in amount from 10 to 110 c.c. In the one fatal case the injection was made on the fifth day, and then only 10 c.c. in twenty-four hours were used. In very grave cases with

¹ La Riforma medica, 1898, Ann. xiv. t. i. 195.

serious symptoms as late as the fifth day, the quantity of serum injected on the first occasion has been as high as from 120 to 150 c.c., either at once or in two parts. In very severe cases several intravenous injections of 4 to 10 c.c. have been added. The result is always favorable. The injections are followed by a rapid amelioration of the general condition and a fall in temperature. No evidences of intolerance to the serum have ever been noted, even after doses as high as 120 c.c. in twenty-four hours.

Pane believes that at first the pneumococcus is localized in the affected area, but that after a certain length of time it may pass into the general circulation. When a true pneumococcus septicæmia exists the chances for recovery, even under antitoxic treatment, are *nil*. As in the treatment of diphtheria, everything depends on the early initiation of the antitoxic treatment. One of these last nine cases which he reports was an influenza pneumonia. The good effect of treatment was due, he believed, to the fact that the majority of influenza pneumonias, as shown by Weichselbaum, Bouchard, Netter, Menetrier, Birch-Hirschfeld, and others, are due to pneumococcus infection.

Maragliano, at a meeting of the Royal Academy of Medicine of Turin,¹ reported his results in five cases treated by this serum, and testified to the remarkable therapeutic efficacy of the preparation. Not that it totally arrests the course of the morbid process, but that it moderates it. In all cases there was a fall of temperature and an improvement in the general condition with a shortening of the course of the disease. He believes that the substance acts as an antitoxin.

Caruso and Staginitta² report two cases treated successfully by Pane's serum. They conclude:

"(a) The injections of antipneumonic serum give no local reaction, and are as practicable as any other hypodermatic injection.

"(b) The serum has shown no toxic property in its general action.

"(c) The serum has none of those remote unpleasant consequences which are often manifested after the injections of antidiphtheritic serum—fever, morbilliform or scarlatiniform eruptions, arthritic swelling and pain, etc.

"(d) In two cases reported the serum has shown an indisputable efficacy against pneumonia.

"(e) Therefore, in every case of croupous pneumonia, one may resort to serotherapy.

"(f) In a croupous pneumonia with grave prognosis, it is the duty of the physician to advise serotherapeutic treatment."

Gamba, in the discussion of this communication at the Lucisian

¹ La Riforma medica, Ann. xiv. t. i. 439.

² Bull. d. soc. linc. d. osp. d. Roma, xviii., 1898, 235 and 340.

Society in Rome, stated that he also had under treatment two severe cases of pneumonia in which he had been using the serum—one a man of seventy-five years—and both were doing extremely well. He emphasizes the fact that the treatment should be begun as soon as the diagnosis is made, without waiting for the condition to become grave.

Garofalo insists upon the necessity of careful observations of numerous cases in hospitals. At the conclusion of the discussion the society unanimously adopted a resolution recommending the systematic experimental use of Pane's antipneumonic serum in the hospitals of Rome.

Marone¹ reports a severe case of pneumonia in an old man of seventy-two years. Nine c.c. of serum were injected on the fifth day and repeated on the following morning. In the evening again 8 c.c. were given. Ten c.c. were injected twice on the three following days. Though the symptoms were extremely grave, recovery gradually occurred. The serum seemed to have a very stimulating and a distinctly antipyretic effect. He concludes :

- "1. Pane's serum is an excellent antipyretic.
- "2. It regulates the pulse.
- "3. It produces sometimes a transient cardiac arrhythmia.
- "4. It does not affect the course of the pneumonia.
- "5. It is a stimulant rather than an antitoxin."

He believes that the antipneumonic serotherapy should always be tried, inasmuch as it is the best method of cure which we now possess.

At the Ninth Italian Congress of Internal Medicine in October, 1898,² a most interesting discussion took place concerning Pane's antipneumonic serum. This observer has recently succeeded in obtaining a serum of great strength. He has obtained cultures of the pneumococcus which are active in an almost imperceptible quantity, a quantity so small that there is even a danger of not injecting any bacteria, and his serum possesses 1000 to 3000 immunizing units. He believes that there is but one species of pneumococcus. He reasserts the statement above mentioned, that at first in man, as in rabbits, the infection is local; at this time the serotherapy is most useful. No serotherapy can save an individual when the pneumococcus has passed into the general circulation. In double pneumonia with jaundice and albuminuria the doses of the serum must be large, even up to 120 c.c.

Sylvestrini and Aporti made from rabbits an antipneumococcus serum which, in quantities of 10 c.c., produced a favorable influence upon the temperature in pneumonia; but after a certain amount of trial they abandoned their experiments with men, because they could not succeed in producing any appreciable change in the course of the disease.

¹ *La Riforma medica*, 1898, xiv. i. 583.

² *Ibid.*, Ann. xiv. t. iv. 246, and *Lancet*, 1898, ii. 1075.

Baduel asserts that true septicemia is the rule in pneumonia, having been found in 55 out of 57 cases in the clinic in Florence, not only in grave but also in mild cases.

Panc has not observed any other striking effects after the use of the antipneumonic serum excepting the fall in temperature. In answer to a question of Sylvestrini, he stated that to treat properly some cases of pneumonia one had to use as much as 300 or 400 c.c. of serum, to obtain which from thirty to forty rabbits had to be made use of. In answer to Baduel, Panc stated that many researches, both by Belfanti and by others in Florence and Rome, have shown that as a rule the pneumococcus is not to be obtained from the circulating blood, even when as much as from 10 to 15 c.c. of blood are taken for the culture.

Belfanti states that Panc's serum has a preventive influence if inoculated before the beginning of a septicemia and has a marked agglutinating and bactericidal action. The toxic substances in pneumonia are very difficult to separate. Carbone has extracted a phlogogenic substance from the bodies of pneumococci, while Zenoni has found an extremely powerful soluble poison, which is, however, very unstable. It produces marked hemolysis. Against this poison Panc's serum has no influence. His own antipneumococcic serum has not produced as good effects as Panc's, but he believes the statistics with regard to the use of the latter, while favorable, are as yet insufficient. Belfanti has also observed that when the pneumococci appear microscopically in the blood it is never possible to save the animal.

Panc believes that in pneumonia the direct action of the pneumococci plays a part more important than a circulating toxic substance.

Massalongo and Franchini at the same session report upon the treatment of ten cases of pneumonia with Panc's serum; all were at an advanced period of the disease, "old in years or in misery, fatigue and debauch," and almost all chronic alcoholics, cardiopaths, nephritics, or arthritics. After having compared these cases with others treated in the ordinary manner they conclude:

"1. By the use of Panc's antipneumonic serum in very grave cases of pneumonia, in arthritic, nephritic, cardiopathic, and alcoholic patients who were also advanced in years, we have obtained curative results superior to those reached by any therapeutic means which are yet available.

"2. Panc's antipneumonic serum, contrary to curative methods in acute pneumonia which have been known up to the present time, appears to have a direct action on the evolution of the pneumonic process, hindering its diffusion and facilitating resolution."

Cantieri likewise reports 17 cases treated with Panc's serum with a mortality of 10.5 per cent. He believes that one may rely upon this

remedy in croupous pneumonia to destroy the most dangerous element of the pneumonia, thus leaving the pneumonic process to run its course under "natural physiological conditions."

Bozzolo has used Belfanti's serum without much effect, but acknowledges that his doses were small as compared with those which Pane has given. He advises the use of this method in a large number of non-selected cases.

De Renzi believes that the efficacy of this method is beyond a doubt, and earnestly recommends its use. "The last drop of water may turn the scale, and the elimination of this small part of the infection may just save a patient."

Maragliano has treated successfully five cases selected from among the gravest. He is impressed with the beneficial action of the serum upon the toxæmia. "The existence of the antitoxin once demonstrated, there is no doubt of the efficacy of the antipneumococcic serum."

Fanoni¹ has used the serum in one instance. In a severe case of pneumonia of the right lobe 10 c.c. were administered on the fourth day, and two similar injections were repeated each day for three days more. "A few hours after the first injection the patient began to feel a little relief; the fever gradually diminished and on the ninth day entirely disappeared."

As a result of the above-mentioned observations it would seem to be highly desirable that a more general test of Pane's serum should be made. We should not expect a panacea, but the results which have been obtained justify us in hoping that before long we shall possess an antitoxin which will save many lives.

TREATMENT BY SERUM FROM CONVALESCENTS. Weisbecker² treated 26 cases of pneumonia with serum from convalescents—the same method which he has used in typhoid fever. Ten to 15 c.c. of serum were used. His results were extremely favorable, particularly when the injections were made soon after the onset. The most marked effect was upon the general condition of the patient (the pneumonic process in some instances, however, continued through its usual course), the toxic symptoms being much relieved, while the patient was relatively free from subjective symptoms.

There were but two fatal cases: one, a man of seventy-eight years, who died of heart-failure, and one a woman of fifty-four years, with extreme emphysema.

Weisbecker's communication upon this subject, as upon his own antitoxic injections in typhoid fever and other infectious diseases, is interesting, but not wholly convincing. His cases are, as yet, too few to justify

¹ New York Medical Journal, 1898, lxvii, 646.

² Muench. med. Wochenschrift, 1898, xlv, 202, 238.

any positive conclusion as to the value of the method. There are many objections to the extensive inoculation of serum from one individual into another. The simplicity of the method, however, might recommend its application in selected cases in family epidemics.

Prophylaxis. Eyre and Washburn¹ have made a number of observations relative to pneumococcus infection and the immunization of animals. They find that by growing pneumococci on a special medium (agar streaked with sterile rabbit's blood) the organisms retain their virulence long enough for experiments to be carried on carefully through a considerable length of time. They conclude as follows:

"1. The pneumococcus when cultivated upon the medium described will maintain a constant virulence for a long period.

"2. Rabbits and mice are very susceptible, and to an equal degree guinea-pigs are refractory; but marked individual variations in susceptibility are observed; fowls are absolutely immune.

"3. The virulence toward guinea-pigs can be increased by repeated passages through a series of these animals without any alteration occurring in the virulence toward mice.

"4. The normal sera of the rabbit, guinea-pig, and fowl in doses of 0.5 c.c. will not protect against ten times the fatal dose of a living cultivation, but will protect against the minimal fatal dose.

"5. The antistreptococcic serum of the horse has no protective power.

"6. Antipneumococcic serum can be accurately standardized by using the method above described.

"7. The agglutinative power of a serum bears no relation to the protective power, although the serum of the immune contains more agglutinative substance than that of the normal rabbit.

"8. There is no definite relation between the protective power of a serum and its bactericidal properties as tested by plate cultivations."

YELLOW FEVER.

Etiology and Manner of Infection. In 1897 Sanarelli isolated the bacillus *icteroides* from the blood and tissues of seven out of thirteen cases of yellow fever. This organism resembles the bacillus X found by Sternberg, in 1890, in the intestinal contents of about one-half of the cases of yellow fever examined by him at autopsy. A discussion has been carried on between Sternberg and Sanarelli in the *Centralblatt für Bacteriologie* as to the relationship between these two organisms. There are certain differences as to the motility and the production of gas, acid, and indol, and Sternberg now recognizes that they are not iden-

¹ Journal of Pathology and Bacteriology, 1898, v. 13.

tical, but he believes they are nearly related or varieties of the same species. He reports¹ the observations of Reed, who found that the serum prepared by Sanarelli, by the repeated inoculation of horses with the toxins of bacillus ieteroides, agglutinates bacillus X in a dilution of 1 to 150, and that the serum of a dog immunized to bacillus X agglutinates bacillus ieteroides in a dilution of 1 to 300. A dog immunized to bacillus X received into a vein 25 c.c. of a recent culture of bacillus ieteroides, and five days later 40 c.c. more. He was not seriously affected, although this organism is highly virulent to dogs. Reed² injected cultures of bacillus X into the veins of dogs after the method of Sanarelli, producing vomiting and diarrhoea with bloody stools, which are the same symptoms as those produced by bacillus ieteroides. Gauthier³ found the bacillus ieteroides in the blood of a yellow fever case in quarantine at Marseilles.

Wasdin⁴ found the bacillus ieteroides in 42 per cent. of cases examined in Louisiana and in three cases at Havana. Many individuals not having yellow fever were examined, but in none was this bacillus found.

Novy⁵ made a study of the bacillus ieteroides and the bacillus described by Havelberg as the organism of yellow fever. He believes that neither is concerned in the etiology of the disease. Havelberg's bacillus proved to be a non-motile colon bacillus, resembling Emmerich's bacillus napolitanus. When injected into subcutaneous tissue of an animal a local abscess results, followed by recovery. He finds that the bacillus ieteroides belongs to the typhoid group. Clinical and hygienic experience indicates that the real germ of yellow fever is probably destroyed by cold, but Novy showed that the bacillus ieteroides will grow after being frozen for three days at -10° C. He showed that the blood of normal human beings and that of many animals will agglutinate the bacillus ieteroides when used pure and in a dilution of 1 to 10, and only occasionally in higher dilutions.

The Archinards and Woodson,⁶ however, found that the blood of yellow fever patients in a dilution of 1 to 40 agglutinated the bacillus ieteroides in 70 per cent. of forty cases. The agglutination experiments, therefore, on the whole strongly support the specificity of the bacillus ieteroides. The methods and reasoning of Sanarelli are open to criticism in many respects. He found, when the toxins of bacillus ieteroides were inoculated into the veins of dogs, that vomiting and diarrhoea resulted, that the organs showed fatty degeneration, and that there was a hemor-

¹ Transactions of the Association of American Physicians, xiii. 61.

² Journal American Medical Association, xxx. 233.

³ Revue d'Hygiène, xx. 884.

⁴ Public Health Reports, xiii. 1265.

⁵ Medical News, lxiii. 326 and 360.

⁶ New Orleans Medical and Surgical Journal, l. 455.

rhagic gastro-enteritis. Noxy produced the same symptoms and pathological conditions by inoculation of other organisms, including different varieties of the colon bacillus. Sanarelli injected the toxins of the bacillus icteroides into human beings, producing vomiting, depression, and suppression of urine. These experiments were unjustifiable on the grounds of humanity and at the same time of no value in proving the relation of the organism to yellow fever, as we are in ignorance of the effects which would be produced by the products of other organisms when injected into man. It is possible that the colon bacillus and many other bacteria might produce the same symptoms as those obtained by Sanarelli.

Sanarelli found his bacillus in only seven out of fourteen cases at autopsy, and in explanation says that its growth may have been checked by the presence of its own toxins and secondary infections with other organisms. The amount of soluble toxin produced by it in cultures is not great, however, and secondary infections are not especially frequent in yellow fever. The small proportion of positive results at autopsy should not have much weight against the claims of this organism. The bacillus pestis, bacillus typhosus, diplococcus intracellularis, and other organisms have been found in the blood of patients during life, while the cultures at autopsy were negative. It is, therefore, important for the settlement of the etiology of this disease that proper blood cultures be made during life.

Klebs¹ studied the organs of two cases of yellow fever. He found certain sharply defined bodies in and between the liver-cells, which stained bright red with a mixture of para-fuchsin, kresol, methylene-blue, and methylene-green. Similar bodies were found in the gastric mucous membrane, and also blackberry-like bodies having the same staining reaction. He puts forward the theories that these bodies are protozoa, which penetrate the gastric mucous membrane, sporulate there, and reach the liver by way of the lymphatics. The bodies in the liver had been previously described by Councilman.² The idea of their being micro-organisms occurred to him, but further investigations by him proved that this could not be so, as he found them "in rapidly advancing cases of cirrhosis of the liver, in phosphorus poisoning, and in other cases of rapid fatty degeneration; but they were more particularly found in cases of acute yellow atrophy of the liver." He considered them to be "necrotic masses." The bodies found by Klebs in the stomach-wall are evidently identical with the bodies described by Hansemann³ as occurring in normal gastric mucous membrane and

¹ Journal of the American Medical Association, xxx. 881.

² Sternberg's Report on Yellow Fever, Marine Hospital Service, 1890, p. 151.

³ Virchow's Archiv, cxlviii. 349, and cxlix. 196.

in various pathological conditions, catarrhal hemorrhagica, and phlegmonous, including acute infectious diseases and phosphorus poisoning, but particularly in gastric polyps. They are probably identical with Russell's fuchsin bodies,¹ which have frequently led to the erroneous announcement of protozoon infection.

Diagnosis. Guit  ras² gives three important points in diagnosis: 1. Characteristic facies, which develops between the fifth and twenty-fourth hour of the disease. The face is more flushed than in any other disease at so early a period, and jaundice is already present, as can be seen by lifting a fold of skin, and thereby blanching it. 2. After an initial rise in frequency of the pulse there is a drop, while the temperature is still rising. The pulse may fall to 30 in convalescence, but this occurs also in other diseases. 3. Albuminuria is present on the second or third day. This may occur also in severe cases of other infectious diseases, but it is present even in mild cases of yellow fever. Jaundice may appear early in dengue, but there is never a falling pulse with rising temperature.

P. E. Archinard, R. S. Woodson, and John J. Archinard³ report favorably on the value in diagnosis of agglutination of bacillus *icteroides* by the blood of yellow fever patients. Normal blood undiluted or in small dilutions will cause agglutination. A dilution of 1 in 40 should be used with a time limit of one hour. The phenomenon may occur as early as the second day.

Lereh⁴ reports one case in which the bacillus *icteroides* was agglutinated by the blood in a dilution of 1 in 40 in twenty minutes.

Pothier⁵ made agglutination tests in a small number of cases. There was apparently more or less clumping in 70 per cent. of the cases at a dilution of 1 to 10. Owing to the small dilution and the indefiniteness of the descriptions, no conclusions can be drawn from these observations.

It is to be hoped that agglutination will give us a certain means of diagnosis in this disease, so that the experience in Texas last year may not be repeated. An epidemic prevailed at Galveston and Houston which showed characteristics of yellow fever, but with a low mortality. Observers are divided into two rival camps as to whether it was really yellow fever or dengue.

Treatment. Sanarelli⁶ reports the first trials with his curative serum. It is prepared in the usual way by repeated injection of toxins into horses. The serum used was from two horses which had been treated

¹ Lubarsch-Ostertag. *Ergebnisse der allgemeinen Pathol.*, 1894, ii. 181.

² *University Medical Magazine*, x. 389.

³ *New Orleans Medical and Surgical Journal*, l. 155.

⁴ *Journal of the American Medical Association*, xxx. 460.

⁵ *Ibid.*, 884.

⁶ *Annales de l'Inst. Pasteur*, xii. 348.

for twelve and eighteen months respectively. The serum is bactericidal in its action and not antitoxic, as is shown by the fact that a dog which was being immunized was not protected against the effects of the toxin, but showed the usual symptoms—vomiting, prostration, and fever—undiminished after each new dose. Therefore with this serum there is hope of benefit to the patient only when a fatal dose of toxin has not yet been formed in the system. The first trial was made at the Hospital of St. Sebastian, at Rio de Janeiro. Eight cases each received 80 c.c. of the serum. Five of them were at the fourth day of the illness, and four were anuric and in delirium. Five recovered. The second trial was at San Carlos do Pinhal, in the State of San Paulo, in the interior, where an epidemic of exceptional severity was raging with a mortality of 80 to 90 per cent. After the first eight cases intravenous injections were employed, which proved to have much better effect. After the injection there are congestion of the skin and conjunctivæ, strengthening and slowing of the pulse, and nausea. Several hours later there is a rise of temperature, followed by a fall, with amelioration of the symptoms, absence of hemorrhage, and increase of urine. The best results were from a single large dose. Certain precautions were necessary, as it was found that patients reacted differently. Reaction was very strong when the injection was made early in the illness and in patients with malarial enlargement of the spleen or myocarditis. Cases with vague or slight symptoms were not treated. Twenty-two cases received injections, with a mortality of 27 per cent., which Sarsarelli thinks encouraging, as the epidemic was very severe, and the fatal cases included a very rebellious patient, a woman one month after confinement who was nursing two children, and a case of chronic malaria with remarkable hypertrophy of the spleen and liver. He hopes for better results with a stronger serum.

PROPHYLAXIS. One test of the serum as a prophylactic was made in the prison at San Carlos, where three fatal cases had developed. All the inmates not protected by a previous attack received injections, and no further cases appeared although the epidemic continued in the town.

Haralson¹ points out that the spread of the disease can be checked without disturbing commerce if the first infection is discovered early. The difficulty lies in the fact that practising physicians are reluctant to disclose the existence of cases in their towns on account of the unpopularity and professional loss that are sure to follow. He recommends that inspectors free from local influences be appointed by the State Boards of Health.

Doty² writes of the hygienic methods of preventing the spread of

¹ Medical Record, Miss., ii. 1.

² North American Review, clxvii. 681.

yellow fever. Internal quarantine is ineffectual, and involves great commercial loss. Good paving and sewers and cleanliness are of more value and would not be so costly. Yellow fever never flourishes in a city where proper attention is given to municipal hygiene. At present it is of the greatest importance to this country that Havana be properly paved, sewerred, and cleansed.

LARYNGOLOGY AND RHINOLOGY.

By A. LOGAN TURNER, M.D. EDIN., F.R.C.S. EDIN.

THE PHARYNX AND LARYNX.

The Three Tonsils as Channels of Infection. The importance of the lymphatic tissue in the fauces, the naso-pharynx, and the base of the tongue as a gate of infection for organisms has for some time been fully recognized. It may not, however, be out of place to review some of the more recent work that has been done in this field, and to see how far later researches support the conclusions which have already been arrived at on this matter.

The epithelium covering the surface of the hypertrophied faucial tonsils is considerably thickened, and at the external openings of the crypts the same condition is found; in the deeper parts of these crypts, however, this excess of epithelium is not found, so that no obstacle is offered to the entrance through them of organisms from without. Attention has recently been drawn to a region of the faucial tonsil which is believed to be an excellent starting-point for infection. The anatomy of this region has been described by Killian¹ from a study of one hundred and five anatomical preparations and from an examination of one hundred living persons. He found that there exists immediately below the semilunar fold of mucous membrane which covers the upper part of the tonsil in front, and which he calls the *margo semilunaris*, a depression or chink. This depression is the opening into a relatively large cavity lying in that area of the tonsil which is concealed by the soft palate. He called this opening the *hilus of the tonsil*. In 82 out of 100 individuals whom he examined he found that a probe entered from this point to a mean depth of 1 cm. into the soft palate, either forward, upward, and outward, or backward, upward, and outward. This opening could be examined more readily by means of a rhinoscopic mirror, at the same time that the head was turned slightly to the same side, the tongue extruded, and the cheek of the opposite side held back.

Paterson,² of Cardiff, has given a detailed description of this cavity or space, which was first noticed as a distinct anatomical space by His,

¹ Revue hebdomadaire de Laryngologie, Bordeaux, October 16, 1897; and Archiv für Laryngologie, Berlin, 1898, Bd. vii. Hefte 2 and 3.

² Journal of Laryngology. London, April, 1898.

and called by him the supratonsillar fossa. If the anterior palatal arch is carefully observed there may be seen a fold of mucous membrane arising from its free border and stretching backward toward the tonsil, which it partially covers; this fold is usually triangular in shape, and has been named by His the *plica triangularis*. Its apex blends with the anterior palatine arch and becomes lost in the *velum palati*; its base disappears in the structures at the root of the tongue, while its free edge may extend over the tonsil for a variable distance, and even be closely adherent to it. Immediately behind this fold or plica lies a cavity which may enter the soft palate for a variable distance, and into which a suitably curved probe may be passed. This cavity is the supratonsillar fossa, and is in no sense a dilated tonsillar crypt or lacuna. From the point of view of development the position of this fossa may be accurately defined. The anterior palatal arch is derived from part of the second visceral fold, and forms the division between the mouth proper and the pharynx; behind it lies the cleft between the second and third visceral arches. The faucial tonsil is formed by the development of lymphoid tissue in this cleft, while the upper part of this space—that is, the remainder of the cleft unoccupied by the tonsil—constitutes the supratonsillar fossa. The size of this space must be influenced, therefore, partly by the development of lymphoid tissue and partly by the disposition of the *plica triangularis*.

The fossa may be prolonged downward in front of the tonsil, or it may stretch outward behind the palato-glossus muscle almost to the lower jaw. It may bend over the apex of the tonsil and dip down on its outer or deep surface. Its extent in the soft palate varies considerably, but it may come so far forward as to leave little more than a layer of mucous membrane separating it from the mouth. Posteriorly it has been found to extend backward, separated from the naso-pharynx only by a thin layer of the palato-pharyngeus muscle and mucous membrane. Changes may take place in the plica of such a nature as to affect the outlet of the fossa and convert it into a closed sac with only a small opening.

Enough has been said to show that this space is a distinct anatomical entity, and it undoubtedly possesses a clinical interest. It may become the seat of suppuration which may drain in a very imperfect manner, and, hence, give rise to continuous throat irritation. It may be the seat of calculous formation, or masses of *leptothrix* may grow in it and lead to attacks of pharyngomycosis. Killian considered this fossa of great importance in the etiology and treatment of peritonsillar abscess, and it is highly probable that it forms the starting-point in many of these cases. The proximity, in many instances, of the cavity to the buccal mucous membrane covering the soft palate will explain the great tendency which these abscesses have to point on the anterior surface of the soft palate.

Killian, indeed, has given up the ordinary incision through the soft palate in cases of peritonsillar abscess, and opens them through the supratonsillar fossa by means of a probe introduced into the abscess by this route. Paterson¹ has found pyogenic organisms in great abundance in the supratonsillar fossa, and he has observed, in the early stages of lacunar tonsillitis, fulness and tenderness over the palatal arch, followed by signs of inflammation in the upper part of the tonsil itself, all suggesting that the inflammatory process had commenced from an infection of this fossa. He also describes a tubercular nodule which he found growing in the floor of this cavity in a man who had died of pulmonary tuberculosis. Before death enlarged cervical glands were observed upon the left side, but nothing abnormal could be made out in the left tonsil, even when the plica was pulled aside. Post-mortem examinations revealed the presence of well-developed giant-cell systems extending from the floor of the fossa into the substance of the tonsil. In all probability some of the bacilli-laden sputum had found its way through the opening into this space and there given rise to local infection.

Although it had been generally assumed that the faucial tonsils were capable of absorbing organisms, probably through the crypts on account of the thinner and looser texture of their lining membrane, no experimental proof had been obtained of this. Goodale,² of Boston, however, has published the results of a series of experiments which he made by injecting a watery solution containing minute particles of carmine. This was introduced into the crypts of hypertrophied tonsils in twelve cases by means of a blunt, flexible canula attached to a hypodermic syringe. After intervals varying in their duration the tonsils were excised and by means of serial sections were carefully examined with the microscope. In two of the cases the tonsils were excised immediately after the injection had been made, and in both of them the result was negative. In one, twenty minutes elapsed before the tonsils were removed, and the sections then showed that fine particles of carmine had passed into the lining membrane of the crypts between the tissue cells. The carmine lay in the immediate neighborhood of the leucocytes that were present in the mucous membrane. In five cases a longer interval, varying from forty-five minutes to two hours, was allowed to elapse, and it was found that the depth to which the carmine particles had penetrated was proportionate to the length of time that the tonsils remained in the throat after the injection. The carmine was found between the follicles or germ centres, but not in their interior. In one case, two days after injection, carmine was found in the lacune and in the tonsillar tissue, while in two others, examined after an interval of five days, little or no carmine was

¹ The Laryngoscope, St. Louis, July, 1898.

² Archiv für Laryngol, Berlin, 1897, Band vii. Heft 1.

seen in the lacunæ, but it was present both in the lining membrane and in the lymph spaces beneath it. In one case, after ten days, there was still some carmine in the crypts, and in the tonsillar tissue the particles were seen to be arranged more or less in parallel lines and lying between the follicles in the intercellular spaces along with the leucocytes. At the same time the sections were stained for micro-organisms, and while they were found in abundance in the lacunæ they were not present in the tonsillar tissue save in the superficial layers of the lining epithelium. Goodale concluded that while bacteria might continually make their way into the tonsils, they encountered conditions which terminated their existence, and that inflammation of the tissues might, possibly, be set up by the absorption of ptomaines from the organisms lying in the crypts.

Kayser,¹ of Breslau, experimented with a similar end in view, by blowing particles of fine coal dust against the tonsils of human beings and cats, and then, after an interval, removing them. The following results were obtained: 1. After a quarter of an hour numerous fine particles were found in the interior of the tonsillar tissue under the epithelium. 2. The longer the time that elapsed, the deeper were the particles found, while they were less numerous superficially. 3. The dust particles were found partly in the leucocytes, partly in the tissue spaces. 4. In animals, after a certain time, dust particles were found in the lymphatic glands. It is interesting to observe that Goodale² has recently applied the knowledge which he gained from his injection experiments to therapeutic purposes. In certain cases of cervical gland enlargement he injected a 10 per cent. aqueous solution of iodine into the tonsillar crypts. Three or four drops of this solution were drawn into a syringe, and in this way introduced into a crypt. The injections were repeated every third or fourth day, and in most of the cases a reduction in the size of the glandular swelling took place. In some of the cases no improvement resulted.

It has long been recognized that the tonsils become inflamed in many acute infectious diseases, but it is quite possible that the tonsillar crypts may be the gates through which the general infection itself enters. Jessen,³ of Hamburg, records two or three cases of great interest, in which acute septic mischief appeared to have gained an entrance through the faucial tonsils. A woman, aged twenty-eight years, was admitted into the hospital in a comatose condition, and died in twelve hours. The cause of death was ascertained to be pyæmia, and no other entrance of the infection could be found save through the tonsils, in which suppurative foci existed, and, as these small abscesses appeared to be older than similar processes in some of the other organs, they appeared to

¹ Report of Moscow Congress, in *Journal of Laryngology*, April, 1898.

² *Boston Medical and Surgical Journal*, May 19, 1898.

³ *Münch. med. Wochenschrift*, June 7, 1898.

indicate the source of the general infection. A girl, aged thirteen years, suffered from an angina of the left tonsil, from which streptococci were obtained; there followed upon this pneumonia, pleurisy, pericarditis, and nephritis, along with other signs of septic mischief. Streptococci were found in her sputum, and the general infection appeared to have gained admission through the tonsil. A third and somewhat similar case, originating in a tonsillar inflammation, is also recorded, and here staphylococci were found in all the diseased organs. At the onset of the disease the source of the infection may escape notice, as the patient is not observed while the throat is inflamed. While admitting that a diagnosis of influenza might be made, Jessen draws attention to the fact that tonsils with a normal surface appearance may contain foci of suppuration. Further, if an exudation is seen upon the surface, and at a later stage such abscesses are found in the substance of the tonsil, it is natural to assume that the organisms have entered from without. He thinks that those cases characterized by a severe general infection may be recognized as tonsillar in origin from the fact that the exudation is not situated in the lacunæ, but exists in long yellow or yellowish-white streaks extending from above downward over the surface of the tonsils. Treatment must be energetically applied to the fauces, and the appearance of such an exudation as that just described must lead the observer to a more guarded prognosis. The subject is one of much interest, and we shall welcome further observations upon it.

The importance of the faucial tonsils and adenoid tissue in the nasopharynx as a gate of infection for chronic tubercular disease has been more fully recognized. The results of various investigators in this field differ as to the frequency with which evidence of a local tubercular condition is met with, but the possibility of the occurrence of such cannot be too fully insisted upon. In many cases the origin of cervical glandular enlargement must be sought for in the fauces of the nasopharynx. There is nothing in the external appearance of the tonsils or adenoid vegetations to suggest that they are anything else than masses of simple hypertrophy, and the possibility, therefore, of their containing tubercular foci may be overlooked. The presence of enlarged cervical glands should make the removal of hypertrophied tonsils or adenoids imperative. Strassmann, Dmochowski, Kruckmann, and others have demonstrated the existence of tubercle in the faucial tonsils, and their observations have been confirmed recently. Hugh Walsham,¹ of London, has worked at this subject from two aspects: he has examined the faucial tonsils removed post mortem from cases of tuberculosis, and, further, has carried out a similar examination upon tonsils and adenoid vegetations

¹ The Lancet, London, June 16, 1898.

removed from living patients. Out of thirty-four consecutive post-mortem cases the tonsils were more or less tubercular in twenty. He has been led to conclude that the tonsil may be the primary source of infection in some cases, while in others they have become infected from the passage over them of sputum laden with tubercle bacilli. In his examination of tonsils removed from living persons, on the other hand, his results were negative.

In Walsham's examination of naso-pharyngeal adenoids removed by operation a similar negative result was obtained; this result is in keeping with that arrived at by Gouze,¹ who could find no trace of tubercle in 201 cases examined both microscopically and by inoculation. In contradistinction to these negative investigations, others of a more positive character may be enumerated. Thus, Pillet² found histological evidence of tubercle in 7.5 per cent. of naso-pharyngeal adenoids. Lermoyez³ published two cases of vegetations which consisted almost entirely of tubercular tissue and tubercle bacilli. Dieulafoy,⁴ after inoculating guinea-pigs with portions of adenoid tissue from thirty-five patients, obtained tubercle in 20 per cent., and histological examination by the same observer revealed evidence of tubercle in 5.7 per cent. Brindel⁵ succeeded in getting positive evidence in 12.5 per cent., while G. Gottstein,⁶ working under Störk, of Vienna, also found 12 per cent. Pluder and Fischer,⁷ of Hamburg, who examined thirty-two cases of adenoid hypertrophy, found microscopical signs of tubercle in five—*i. e.*, 15.6 per cent. McBride and Logan Turner⁸ had a lower percentage than any of those already noted, as their microscopical examination of 100 cases showed only 3 with evidence of tubercle; in two there was subsequent involvement of the superior deep cervical glands upon one side. The most recent observations published on this subject were made by Milligan, of Manchester,⁹ who, in a series of inoculation experiments upon guinea-pigs, found 16.4 per cent. of the vegetations to be tubercular, while Brieger,¹⁰ in a communication made to the Seventh Congress of the German Society of Otology, obtained evidence of the presence of tubercle in five cases out of seventy-eight examined histologically—*i. e.*, 6.5 per cent. It is interesting to note that this observer obtained only one posi-

¹ Ann. des Malad. de l'Oreille, etc., Paris, May, 1897.

² Bull. de la Société anatomique de Paris, vol. vi. fascic. 8.

³ Ann. des Malad. de l'Oreille, etc., Paris, 1894, p. 979.

⁴ Bull. de la Acad. de Médecine, Paris, April 30, May 7 and 14, 1895.

⁵ Rev. hebdomadaire de Laryng., Bordeaux, July 25, 1896.

⁶ Berliner klin. Wochenschrift, August, 1896, Nos. 31, 32.

⁷ Archiv für Laryngol., etc., Berlin, 1896, Band iv. Heft 3.

⁸ Edinburgh Medical Journal, April, May, June, 1897.

⁹ Journal of Laryngology, London, September, 1898.

¹⁰ Zeitschrift für Ohrenheilk., Band xxxiii. Heft 2.

tive result after inoculation with the pharyngeal tonsil removed from twenty patients. The detection of tubercle bacilli in the tissues is difficult, the more so if they exist in small and scattered numbers, as they do in the tonsils and in post-nasal growths, and the majority of observers have failed to detect them in these tissues. We have not to deal with tubercle in an active state, but rather with a quiescent form, not inaptly described by Dieulafoy as "latent tuberculosis." It is possible that there may be a larger number of tonsils and adenoid vegetations thus infected than the above percentages indicate. The tubercle nodules are scattered and more or less isolated; they may occur in outlying lobules of the lymphoid tissue, and they may not extend through the whole depth of the tissue; unless the entire mass of the removed adenoid tissue be cut in serial sections and examined, evidence of this form of infection may escape detection.

As regards the lingual tonsil at the base of the tongue, Walsham concluded that it was very rarely found tubercular. That septic infection may take place through this structure is probable, and those cases of angina epiglottidea anterior, which are occasionally met with, may possibly originate in that way.

"Pressure Pouch" of the Œsophagus. Butlin, of London, has again brought this interesting affection before the notice of the profession. In addition to the case which he published in the *Transactions of the Royal Medical and Chirurgical Society of London* in 1893, he has had opportunities of observing five other cases.¹ In his opinion this is an extraordinary experience, to be accounted for either by the fact that chance has been strangely disposed toward him, or that pressure pouches of the œsophagus are not so rare as they have been supposed to be. All his patients were men, the youngest of them being more than forty-five years of age, while in all of them the symptoms of the pouch were first noticed after forty years of age. It would not be out of place to very briefly touch upon the leading facts in these five cases.

CASE I. A gentleman, aged fifty-seven years, had suffered for ten years from slight difficulty in swallowing his food; this difficulty had gradually increased, and in spite of every device and care, portions of food would come up unchanged many hours after they had been swallowed. His general health was good and he had not lost flesh. By means of a certain movement of his neck he was able to bring up fragments of food which he had taken on the previous evening. No bulging had been noticed in the neck.

CASE II. A gentleman, aged seventy-three years, had been troubled for four years with difficulty in swallowing and with the return of fragments of food long after they had been swallowed. Swelling had been

¹ British Medical Journal London, January 1, 1898.

noticed in the neck after the taking of food. A curved sound was passed into the pouch and the end of it distinctly felt in the posterior inferior triangle of the neck, on the left side. In this patient the pouch was removed by Butlin through a long incision made on the anterior border of the left sternomastoid with its centre opposite the cricoid cartilage. In the dissection the trachea and œsophagus lay on the inner side, while the great vessels were drawn to the outer side of the wound. The pouch was found lying behind the œsophagus at its junction with the pharynx and projecting a little toward the left side. It was cut away from above downward, and the edges of the wound in the œsophagus were brought together with fine silk stitches. No tube for feeding purposes was kept in the œsophagus, and, although for a short time liquids came out through the wound in the neck, healing and recovery eventually took place.

CASE III. A gentleman, aged sixty-five years, had experienced difficulty in swallowing for more than a year, and, like the other patients, could swallow liquids better than solids. He had not lost flesh. Fragments of undigested food were brought up after long intervals, and by pressing upon the neck some water could be returned into the mouth immediately after it had been swallowed. A sound was arrested nine inches from the teeth.

CASE IV. A gentleman, aged fifty-five years, had complained for five years of some difficulty in swallowing. The dysphagia commenced suddenly by stoppage in his throat during a meal, this being the only case in which a sudden onset was described. Symptoms similar to those in the other patients followed, and a bougie which was passed was arrested nine inches from the teeth. The pouch in this case was removed by another surgeon, and was found to be like the one excised in Case II., and occupied a similar position.

CASE V. A gentleman, aged fifty-seven, had suffered for six years from the return of fragments of food from time to time. His general health was excellent, and he had not become thinner. He could himself demonstrate the presence of the pouch, and after swallowing water, by leaning forward, he allowed the fluid to be returned from it; he could also press solid food out of the pouch and introduce an instrument into it for a distance of nine inches from the teeth.

The symptoms of pressure pouch have been mistaken for a dilatation of the œsophagus above a stricture, either innocent or malignant, and gastrostomy has been performed under the impression that such a condition existed. According to Butlin, the pouch is practically always situated posteriorly at the junction of the pharynx and œsophagus, and it opens into the gullet by a longitudinal aperture in the middle line about one inch in length. The return of fragments of undigested food is the one constant symptom in every case; the food, swallowed many hours before,

has been recognized by patients as something they have taken not at the last meal, but at some previous one. Pressure on the side of the neck in the posterior triangle, and usually on the left side, may cause fragments of food and liquids to return into the mouth, and gas may also gurgle up at intervals and prove of great annoyance to the patient. Sometimes bulging in the neck may become evident after a meal. If a bougie does not slip past the orifice of the pouch, it becomes arrested usually at a distance of nine inches from the teeth. The point of the instrument may be felt, and the projection caused by its presence may be seen in the neck. Wasting and loss of flesh are rarely, if ever, observed until the late stages of the disease, the course of which is very slow.

Laryngoscopy, Autoscopy, Bronchoscopy. *Examination of the larynx* in infants and young children presents difficulties which are not met with in adults—difficulties which the ordinary method of laryngoscopy often fails to overcome. A method which combines depression of the tongue in conjunction with traction upon it has been found a useful and valuable one in many hands, and by such means the arching of the dorsum lingue is prevented, while at the same time the epiglottis is drawn forward, thus rendering the superior aperture of the larynx more patent. More than one way of applying this principle has been adopted. Sutherland and Lambert Laek,¹ in a paper upon "Congenital Laryngeal Obstruction," described how they had examined the larynx successfully in six children who suffered from this affection. The infant was held in the usual position for laryngoscopy, the index finger of the examiner's left hand was then passed into the mouth over the base of the tongue, and the terminal phalanx was hooked round the hyoid bone, in this way pressing it well forward; the rest of the finger held the tongue down, while the left thumb, pressed up under the chin, steadied the child's head. A small laryngeal mirror was next introduced in the usual way, and the larynx was brought into view. Instead of the finger, some form of light tongue depressor may be used, such as Fränkel's or Mount Bleyer's, the distal extremity of the instrument being gently passed backward along the dorsum of the tongue to its base, and there pressed into the hollow in front of the epiglottis.

The introduction of Kirstein's *autoscopy*, for direct examination of the larynx without the aid of a mirror, has met with a varying amount of success in different hands. It would be out of place at this date to enter into a description of the autoscope and its technique, but it is, however, interesting to observe² that Kirstein has dispensed with the somewhat complicated instrument which he first devised, and now finds that a tongue spatula only will fulfil all the necessary requirements. After

¹ The Lancet, London, September 11, 1897.

² Berliner klin. Wochenschrift, 1898, No. 12.

careful investigation, he has modelled a tongue depressor which will allow inspection of the respiratory passages in adults in a similar degree to that which the autoscope afforded. At the first glance it might appear impossible, but after an extended trial for nearly two years he has found that such a result can be attained. For the sake of description we distinguish between the tongue portion of the instrument and the handle. The distal end of the tongue part, for a distance of 5 cm., is bent downward, the amount of this curve being equal to 1 cm. In other words, if looked at in a profile view, the distal 5 cm. form the segment of a circle with a radius of 13.5 cm., to which the proximal straight portion of the spatula forms a tangent. At its free distal extremity there is a shallow notch, so as to admit of its more ready approximation against the median glosso-epiglottic ligament. Kirstein lays considerable stress upon the exact amount of curvature of this part of the instrument. If the curve is insufficient, autoscopy of the larynx in many cases is not successful when it would succeed with a more suitable instrument, because the pressure on the tongue necessary for the raising of the epiglottis fails. On the other hand, if the bend is too pronounced, the spatula is useless. The correct amount of curvature had been obtained only by continually testing it. He gives the following measurements, which appear to satisfy the requirements. The length of the tongue portion from the notched extremity to the handle shoulder is about 11 cm.; the breadth is about 15 mm., and the thickness about 3 mm.; the edges of the spatula must be well rounded.

Obtuse-angled spatulae are inconvenient and become inapplicable, because, in the examination of the deeper parts of the larynx and trachea, they would force the observer to excessive ulnar flexion of the hand, and finally to abduction of the upper arm. The handle serves its purpose best if made as short as possible—that is to say, when properly held it is completely covered by the closed hand. Its upper extremity near the shoulder is slightly hollowed out in order to accommodate the terminal portion of the thumb. An intermediate metallic portion between the handle and the tongue-piece should be dispensed with, because with the strong illumination that is used it causes a glistening and dazzling effect upon the eye of the observer.

Illumination may be obtained by means of a forehead lamp, while the patient assumes the position that has been described by Kirstein in his writings upon "Autoscopy of the Larynx." Fletcher Ingals,¹ of Chicago, has modified on Kirstein's lines a tongue depressor previously employed by himself for autoscopic purposes. He has substituted the curve and the notch upon the tongue portion, but near the angle of the instrument

¹ New York Medical Journal, September 17, 1898.

he has two flanges designed to prevent the patient's mouth from closing and obscuring the line of vision; this is a point which he considers of some importance. In the examination of children under chloroform he has had excellent results with this instrument, the patient lying upon his back with the head hanging over the end of the table. I agree with Fletcher Ingals in his remarks upon the intolerance of the majority of patients to the kind of tongue pressure necessary for autoscopy without either local or general anaesthesia.

Mermod,¹ of Yverdon, has again brought before the notice of the profession an instrument designed for the purpose of giving a better view of those parts of the larynx which are not accessible to the eye by ordinary laryngoscopy. This instrument is named "the laryngendoscope." Nothing more than a mere reference is made to this instrument, as a similar procedure has previously been suggested and applied, both by Voltolini and by Rosenberg, of Berlin.

Bronchoscopy. The examination of the trachea through a tracheotomy wound was first attempted by Schrotter and carried out by Pieniazek. Killian,² of Freiburg, has gone a step further and has practised examination of the bronchi through the tracheal wound, applying to this method the term "bronchoscopy inferior." For this purpose the bronchi were first anaesthetized with a 10 per cent. solution of cocaine, and this was followed by the introduction of a tubular speculum through the tracheal wound, illumination being obtained by means of an electric forehead lamp. In a patient who measured five feet six inches in height he used a tube with a diameter of 9 mm. When this speculum had passed for a distance of fourteen centimetres from the tracheal wound it reached the bifurcation of the trachea and passed into the right bronchus. After carefully inserting the speculum still further he was able to explore the smaller divisions of the bronchi, first the tube leading into the upper lobe, and then that for the middle and for the lower lobes. When measured externally the end of the metallic tube was found to correspond to the fourth intercostal space, and, owing to the narrowing of the bronchial lumen, further insertion was impossible. He found the bronchi strong, elastic, somewhat expansile, and, what was an important fact, displaceable; the ends of their branches were not fixed. The speculum was borne by the patient without pain, and there was no hemorrhage. After he had removed the speculum for a certain distance he passed it into the left bronchus, and observed its divisions passing to the lower and upper lobes of the lung. In a smaller patient, a boy, a narrower speculum was employed.

In addition to bronchoscopy inferior, he has also practised "direct

¹ Ann. des Malad. de l'Oreille, etc., February, 1898.

² Münch. med. Wochenschrift, No. 27, 1898.

bronchoscopy," or examination of the bronchi through a speculum passed into the mouth. The larynx was painted with cocaine, special attention being paid to the epiglottis and posterior laryngeal wall, and the trachea and right bronchus were also anesthetized by carrying the cocaine upon a straight probe, the larynx being brought into view by autoscropy. The distance to the bifurcation of the trachea in a patient four feet eleven inches in height was found to be 27 cm. A tubular speculum 9 mm. in diameter was introduced, which brought into view the openings of the two bronchial tubes, while by further insertion he was enabled to pass the speculum into the right bronchus for a distance of 5 cm., so that its subdivisions became apparent. The subdivision of the left bronchus, on the other hand, was seen at a distance of 4 cm. from its commencement. Difficulty in breathing during direct bronchoscopy was not met with, the patient being able to breathe through the tube. During the passage of the speculum the patient's head was thrown backward as far as possible, while the tongue was held well forward. How far this method of examination will prove to be of any practical value remains to be seen. While Killian obtained a satisfactory examination in a series of cases, it is questionable how far patients will be able to tolerate the insertion of such an instrument so as to make its use of any practical value.

Orthoform in Diseases of the Nose and Throat. The introduction of a remedy possessing the advantage of cocaine without its disadvantages would undoubtedly prove of great practical value. Such an agent has not been found altogether in orthoform, though under certain conditions it has been shown to be a valuable local anesthetic devoid of toxic properties. This drug, introduced to the notice of the profession by Einhorn and Heinz,¹ is a white crystalline powder, light and bulky, almost insoluble in water, and without taste or smell. It is also an antiseptic. Its hydrochloride is crystalline, very soluble, and possesses anesthetic properties, but owing to its acid reaction it is somewhat irritating upon delicate surfaces. The absence of taste and smell enhances the value of the drug as a therapeutic agent in diseases of the nose and throat, while its insolubility, on the other hand, prevents its effective action upon intact mucous membrane. When applied to the tongue, or to the inner surface of the cheek, a numb sensation ensues in about five minutes, but there is little real anesthesia. Younge,² of Manchester, who has experimented with orthoform in relation to throat affections, found that in the larynx reflex irritability was reduced and a peculiar feeling, somewhat resembling that produced by cocaine, was experienced by the individual to whom it was administered, though this soon passed off. A laryngeal

¹ Münch. med. Wochenschrift, 1897.

² British Medical Journal, London, February 5, 1898.

probe could be passed, however, and its presence tolerated without inducing the spasm or cough which had previously followed the use of that instrument. In the nose it has been employed with the view of diminishing the irritability in attacks of hay fever, to which reference will be made.

It is, however, upon ulcerated surfaces that the true value of orthoform as an anæsthetic can be gauged, for it is thus brought in contact with the exposed nerve-endings, and, being sparingly soluble, its action is sustained for a long period; in this way it has been proved to be of great benefit. It has, too, the additional advantage of being non-toxic and antiseptic. Anæsthesia commences in from five to ten minutes after its application, and this may last from a few hours to five or six days. Kallenberger¹ found that the average duration of anæsthesia was for a period of thirty-five hours, while Neumayer,² after insufflating it in laryngeal ulceration, found that the pain and irritation were allayed sometimes for days at a time.

Yonge, in the paper already referred to, describes the various preparations that may be employed. In the form of the crude powder it can be readily insufflated, and if the surface of the pharyngeal or laryngeal ulcer has been previously cleansed, anæsthesia is produced in a few minutes, and the act of swallowing can be carried out without the discomfort or pain previously complained of. Orthoform pastilles may be employed.

He has also made use of a saturated solution of orthoform in collodion, forming a kind of protective varnish. As smarting is at first produced by this preparation, the surface of the ulcer may be brushed with cocaine first. An orthoform spray also forms a suitable means of application, because, on the evaporation of the spirit with which it is made up, the precipitated powder is left in contact with the surface.

It may be used as an ointment, made up with some suitable base, its strength being 10 per cent., and, lastly, a 10 per cent. aqueous solution of the hydrochloride has been prescribed as a paint. Yonge did not find the drug of any value in catarrhal pharyngitis or in quinsy, nor was its anæsthesia sufficient to permit of any surgical operation being carried out, facts which support the non-utility of the remedy upon unbroken surfaces.

Lichtwitz and Sabrazes³ found the drug absolutely non-poisonous, and where dysphagia was a prominent symptom, as in laryngeal tuberculosis and laryngeal cancer, it gave immunity from pain for from twenty-four to forty-eight hours. My own experience with orthoform, in laryngeal ulceration, confirms the views expressed by these and other observers.

¹ Berlin. klin. Wochenschrift, March 21, 1898.

² Münch. medicin. Wochenschrift, 1897.

³ Bulletin Méd., November 21, 1897.

RHINOLOGY.

Deformities of the Nose and their Rectification. Deformities of the nose may result from injury or they may be consequent upon destruction of tissue the result of disease, while occasionally a congenital malformation is met with. To Roe, of Rochester, we are indebted for much valuable assistance in the correction of these deformities. In a paper submitted to the Section of Laryngology and Otology at the Montreal Meeting of the British Medical Association,¹ he classified deformities of the nose, from a surgical stand-point, into those which resulted from an affection of the osseous part of the nose and those in which the cartilaginous portion was at fault. These two groups were again subdivided according to the character of the deformity that was present. Owing to the great variety of causes and conditions of these deformities, the operations required for their correction were equally varied. He emphasized the fact, however, that the operation should be performed subcutaneously from the interior of the nose, and he insisted upon the following points being observed: Thorough antiseptic precautions must be carried out, because if suppuration should take place in the wound the engrafted tissue would be destroyed, and not only would the object of the operation be defeated, but the deformity of the nose would be increased. Further, the plan of the operation must be carefully studied, so that the tissues at the disposal of the surgeon may be utilized to the best advantage. Lastly, great care and attention subsequent to the operation are as important as the operation itself, because the most scrupulous attention must be paid to the healing process. Not only must the parts be held in place by retentive appliances, but the shape of these appliances and the dressing require frequent changing from day to day, as the swelling subsides and union of the parts takes place. Some of the results obtained by Roe in the correction of saddle-back deformities are detailed and illustrated in a paper² read by him before the Medical Society of New York State.

Annandale,³ of Edinburgh, has recently modified and improved an appliance which he has used for some time in the treatment of similar deformities. It acts upon the principle of "slinging" the depressed structures in position, at the same time exercising the proper amount of lateral pressure. The apparatus consists of: 1. A piece of sheet-lead (see Fig. 8, A), formed into an arch with a ledge on each side, which rests upon the cheeks. When placed *in situ* the arch rises higher than

¹ British Medical Journal, London, November 13, 1897.

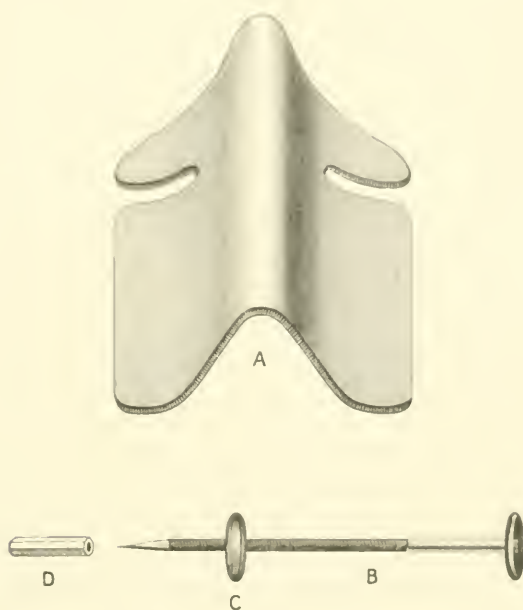
² New York Medical Record, June 5, 1897.

³ British Medical Journal, London, December 4, 1897.

the nasal bones after they are brought into proper position. At the points where the pin is introduced through the nose and where it passes out, a notch is made through the ledge up to the base of the arch. The sheet-lead is pliable and allows the arch and ledge to be easily adapted to the parts.

2. A fine steel pin (B), sharply pointed at one end and with a fixed head at the other; two-thirds of the length of this pin, at the sharpened end, consists of a fine screw, which allows a movable and rounded nut (C) to move along it, and so regulates the lateral compression of the lead arch.

FIG. 8.



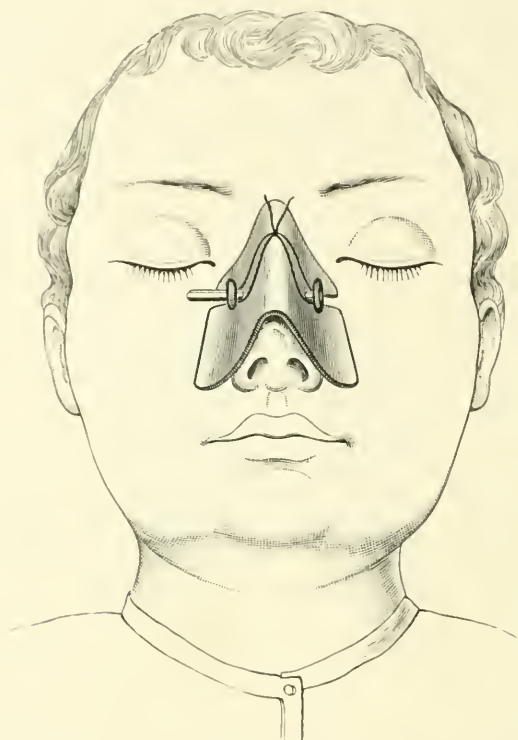
3. A small cap (D), which can be screwed on to the sharp end of the pin, is requisite to prevent wounding of the cheek.

4. A piece of silver wire is necessary.

The operation is conducted as follows: The bones and other nasal textures are first brought into position by external and internal manipulation; the steel pin is then passed through the base of the nose, from side to side, at the point which seems best suited for slinging the bones into position. The lead arch is next fitted on and the silver wire is passed round each end of the pin and, when tightened, is twisted and secured over the dorsum of the arch so as to draw up, and sling, the depressed bones. The movable nut on the pin is now screwed home until the necessary lateral pressure is obtained, the cap finally being screwed on to the sharp point. (See Fig. 9.) If the depression of the

bridge is of old standing, the anterior nares are first exposed by turning up the upper lip after dividing the mucous membrane. A pair of small bone-forceps is then introduced and the nasal bones are separated from

FIG. 9.



their connection with the superior maxillæ. In some cases also the nasal processes of the superior maxillæ are nipped through.

Pegler,¹ of London, has suggested a line of treatment which, with suitable modifications and further improvement, may lead to a useful operation. The case which came under his notice was one in which deformity of the nose had arisen from fracture and displacement of the triangular cartilage. In describing an operation of this kind it is better, perhaps, to quote the author's statement as to the necessary steps. The patient, a young man, when seen a year after the injury, which was inflicted by a cricket-ball, presented the following conditions: The contour of the nose was disfigured by a deep depression of the dorsal surface below the bridge; the anterior margin of the triangular cartilage was split into two lateral portions, and it, together with the two upper lateral cartilages, was probably dislocated. An incision was made along

¹ *Journal of Laryngology*, London, October, 1898.

the middle line of the nose, and the integuments were dissected back on either side. A stout silver wire was then passed through the sunken cartilaginous ridge, from side to side, incorporating the two surfaces of the triangular cartilage which appeared to be separated, care being taken that the needle did not encroach upon the mucous interior. The cartilage, being thus under control, could be raised by the wire at will. The second half of the operation consisted in sawing into the projecting angle of the nasal bones from above, obliquely downward and forward, until the osseo-cartilaginous junction was reached. At this point the sawn fragments (one a larger semi-cartilaginous portion on the right side, the other a smaller bony spicule on the left) were turned down and made to assist in filling up, in an inverted position, the hollow below. A hole was next drilled with a centre-bit through the nasal bone about 2 cm. above the sawn surface, and one end of the wire which had been employed to perforate the triangular cartilage was carried through it. In this way gentle upward traction could be made upon the depressed portion, so as, in some degree, to elevate it to its proper position. The ends of the same wire were next brought together, twisted over the turned down fragments of bone and cartilage, and trimmed so as to lie quite flat on the bridge. The edges of the wound were brought together by catgut sutures. At the time of writing, a few weeks after the operation, the shape and contour of the nose had much improved.

Deviation of the Cartilaginous Nasal Septum. Turning from such operations as the preceding, we must glance for a moment at the deformity that may arise in the interior of the nose, either as the result of traumatism or from developmental changes, namely, deviation of the cartilaginous septum. This varies considerably in degree, with consequent variation in the symptoms produced. Different operations have been suggested for rectifying this condition, and excellent results have been obtained by the operation first performed by Asch, of New York, in 1882. Early in 1898, Mayer, of New York,¹ published the result of two hundred operations for deviated septum performed by Asch's method, and it is with the object of bringing this operation and its excellent results into greater prominence that something more than a brief reference is made to it here. Previous statistics dealing with the results of this procedure have been based upon very few cases; the results of 200 operations are of much greater value. In the New York Eye and Ear Infirmary 122 patients were operated upon, and of these 74 were under the treatment of Asch and Mayer, and all were cured. The youngest patient was five years of age, the oldest sixty-seven, while the average age was twenty years. In 85 per cent. of the cases a perfectly

¹ New York Medical Record, February 5, 1898.

straight septum resulted, and in the remainder, while some degree of curvature was retained, it was not sufficient to cause any stenosis or discomfort. As some of the operations dated back five, six, seven, or eight years, ample opportunity was afforded for judging of the permanency of the cure. Perforations of the septum occurred in about 2 per cent. of the cases, but were only of the size of pin-heads. Certain special instruments have been introduced by Asch, and these may, in the first place, be briefly referred to. Two separators, one blunt edged and one sharp; a pair of straight scissors, one blade being blunt, the other sharp and triangular in shape with the apex of the triangle at the tip of the blade; a second pair of scissors with the blades bent at right angles; two compressing forceps, one with a long beak, the other with a short beak; lastly, hollow tubes of vulcanite, varying in size and shape (Asch's tubes being of five sizes), the lumen of the tube being somewhat oval in shape. These instruments are necessary for the different steps of the operation. The patient is put under the influence of a general anæsthetic, and the operation can then be completed without any further administration of it; the head is drawn well back, so that the blood may not enter the larynx.

The author's own words describing the operation may now be quoted: "The blunt separator is now introduced sideways on the deviated side, in order that any adhesions existing between the septum and the adjacent mucous membrane may be broken up, enabling us at the same time to ascertain the presence of bony obstructions posteriorly. Should these latter exist, or the adhesions be non-yielding, the separator with sharp edges is required; this, however, is rarely necessary. There may be some hemorrhage after the adhesions are broken up, but it is readily checked by an iced spray or by pressure of cotton applicators. The open scissors are now introduced parallel to the floor of the nose, the sharp blade in the concavity, the blunt edge over the point of greatest convexity. They are then firmly closed, the blade cutting through the cartilage into the opposite side with a distinct snap. The scissors are then opened and completely withdrawn. They are immediately reintroduced, the direction of the instrument being upward this time, pointing to the frontal bone, the sharp blade again in the concavity and crossing the line of the first incision at as nearly a right angle as possible and at its centre. In this way the incisions will intersect each other; the scissors are now firmly closed, and thus the second incision is made, after which the scissors are opened and withdrawn. We have now four segments as a result of this crucial incision. The finger is then introduced in the deviated side and the segments are forcibly pushed into the concavity, effectually breaking them at their base. The powerful blunt forceps is now introduced, one blade in each nostril and firmly closed, thus

straightening the septum and forcing the broken segments to override each other in the concavity. The compression aids also in controlling hemorrhage, and the parts are firmly held in apposition. An iced antiseptic solution is sprayed into each nostril, the forceps being withdrawn. The sterilized tubes are then introduced into the nose, a snugly fitting one on the stenosed side and a smaller one in the opposite nostril, thus causing equable pressure, their presence being usually all-sufficient to control hemorrhage. The operation is now completed."

After twenty-four hours the tube is removed from the nostril which had the concavity, and is not again replaced. Twenty-four hours later the tube is removed from the other side, cleaned, and reinserted, unless it prove too large for comfort, when a smaller one is introduced. For the first time the patient is now allowed to leave the recumbent posture. On the third and following days the tube is removed and cleaned, the nose being sprayed at the same time with some warm salt water. The tube is finally withdrawn five weeks after the operation. These tubes are of the greatest service, as they allow of free nasal respiration, and act as splints in keeping the septum straight. The overlapping fragments become firmly adherent, and this destroys the resiliency of the septal cartilage, so that the deformity is thus removed.

In operations upon a deviated septum, where the convex projecting portion is removed with the saw or chisel, some risk is run of producing a perforation from injury of the mucous membrane covering the septum in the opposite nostril. In order to diminish or obviate this risk, Escaut has recently adopted a somewhat ingenious method of protecting the mucous membrane on the concave side. He injects sterilized water beneath it, so that it is raised from the surface of the cartilage which it covers and escapes injury during the operation.

OZÆNA.

The pathology and treatment of this affection are still subjects which exercise the mind of the profession in general and of specialists in particular, and during the last three years considerable discussion has arisen as regards its etiology and in reference to certain modes of treatment which have been suggested. It is not our purpose to discuss at length all that has been written about this distressing condition, but before dealing with some of the more recent and important therapeutic agents employed it would not be out of place to refer briefly to some of the views which have been expressed regarding the possible origin of this affection.

¹ Archives Internat. de Laryngol., etc., July and August, 1898.

What is the cause of ozæna? How are we to explain the origin of the odor? Can we cure the condition? These were questions raised by B. Fränkel, of Berlin, at the International Medical Congress held in London in 1881. Eighteen years later we are still unable to give a definite answer to all of them, in spite of the labor which has been expended with this end in view. Many are the opinions which have been expressed with regard to the etiology of ozæna, but the true explanation of its origin would still appear to be a mystery. It has been suggested that it arises from an anomaly in the development of the parts, namely, in an abnormal width of the nose (a view expressed by Zaufal), while, on the other hand, Berliner has made an unusual narrowness of the nasal cavities answerable for this affection. Michel and Grünwald have doubted the occurrence of ozæna without associated accessory sinus supuration, the former, indeed, having insisted upon the constant presence of an empyema; such a view is no longer tenable. Krause and Habermann described a fatty degeneration of the nasal mucous membrane, the latter concluding that the essential cause of ozæna was a fatty degeneration of the epithelium lining the mucous glands. An interesting paper dealing with these changes has recently appeared from the pen of Cholewa and Cordes, of Berlin.¹ These writers have drawn certain deductions from a histological examination of four cases of ozæna, and from a similar examination carried out on the nasal mucosa of patients who complained of nasal symptoms which were in no sense ozænic. In their ozæna cases they found an infiltration of the mucous membrane with round cells, especially in the subepithelial layer, but extending also into the deeper parts and between the glands. In proportion to the duration and state of progress of this affection, numerous bands of connective-tissue fibres were found, running for the most part parallel to the surface; as regards the presence of fatty degeneration, there was no uniform condition found. In no case were masses of fat granules present, but here and there could be seen isolated, and very minute, fat globules. There was no evidence of a rapid, fatty destruction. Both the round-cell infiltration and such slight fatty changes as the ozæna sections demonstrated had been observed by Cholewa in other nasal conditions; the former was not characteristic of atrophic rhinitis, but might be seen in traumatic and syphilitic inflammation of the nose. The examination of portions of tissue removed from the noses of fourteen patients, in whom ozæna was excluded with absolute certainty, revealed fatty changes similar to those met with in the true ozæna cases. Portions of mucous membrane were removed from individuals variously affected, and at different ages. Diffuse hypertrophy of the middle and inferior turbinates,

¹ Archiv für Laryng., Berlin, 1898, Band viii. Heft 1.

mucous membrane both clinically and macroscopically normal, and mucous membrane of the middle turbinated with polypoid degeneration were some of the conditions examined for this purpose. In all the cases the epithelium of the glands and of the ducts contained more or less numerous fat molecules varying in size. These fatty changes, therefore, could not be looked upon as a characteristic peculiarity of ozena.

Since the discovery, in 1884, of Löwenberg's *cocco-bacillus*, looked upon by him as the specific cause, there has been a greater leaning toward the microbic origin of ozena. Opinions differ as to the exact rôle played by the organism and as to whether the microbic theory is really to be regarded as the correct one; proof of this is still wanting. Various organisms have been described, and various observations have been made which must weaken this theory. Simon¹ has studied twelve cases of ozena from the bacteriological side, and his results may be briefly summarized here. He found a variety of organisms, some of which were constant in all the cases, and others, again, which were only met with in some of his patients. They may be tabulated thus:

Constant . . .	{	Bacillus mucosus (Löwenberg-Abel).
		A bacillus resembling the diphtheria bacillus.
		Fränkel's diplococcus.
		Staphylococcus pyogenes albus et aureus.
Non-constant	{	Friedländer's pneumo-bacillus.
		Bacillus coli.

Inoculations were made from pure cultures of some of these organisms into the nasal cavities of a certain number of tubercular subjects, the organisms thus used being the bacillus mucosus, the diphtheria bacillus, Fränkel's diplococcus, and the staphylococcus pyogenes albus and aureus, and, finally, the crusts from an ozena patient. These experiments gave no convincing results; in no case was ozena produced, and the author was forced to the conclusion that for the development of ozena some special predisposing condition of the mucous membrane must be present. We have in these experiments, therefore, the absence of that all-important proof of the bacillary origin of any affection—namely, its reproduction as the result of inoculation. Similarly, experiments carried out by Löwenberg, upon animals, failed to produce ozena.

At a meeting of the Academy of Medicine of Turin, held on March 27, 1896, Belfanti and Della Vedova² gave an account of their researches into the etiology of ozena, and described a bacillus which they identified with the bacillus of Loëfller. Other observers have since satisfied themselves of the presence of this organism in these cases. According to

¹ Archivio Ital. di Otol., Rin. e Laryng., 4 Fascicolo, Torino, 1897.

² Revue hebdomadaire de Laryngol., Bordeaux, May 2, 1896, No. 18.

Belfanti and Della Vedova, this bacillus resembled the diphtheria bacillus both in its form and manner of cultivation, but differed from it in a marked manner in the attenuation of its virulence, provoking only edema and a moist gangrene of the tissues at the seat of injection. It was found in the secretions of the nose, on the surface of the mucous membrane, and in the diseased tissue itself at some depth. As a result of these observations, the authors resorted to treatment by means of the antidiphtheritic serum, a method which will presently be dwelt upon more fully. Pes and Gradenigo, in July, 1896, confirmed the observations of Löwenberg, Belfanti, and Della Vedova, and described, in addition, another small, slender bacillus which they found constantly present in the crusts and on the nasal mucous membrane of ozena patients. Auché and Brindel¹ have made an exhaustive inquiry into the bacteriology of 24 cases of atrophic coryza, 4 of these being old cases apparently cured. In the remaining 20, in which the disease was in progress, Löwenberg's bacillus was found in every case, the pseudo-diphtheritic in 18, the small bacillus of Pes and Gradenigo in 3, staphylococci in 12, streptococci in 4, while in 1 there was found a large form of micrococcus, and in another, a long thread-like bacterium.

In 14 of these cases ozena was more or less marked; in all of them Löwenberg's bacillus was present, while in 12 of them the pseudo-diphtheritic form was also found.

In the six cases of atrophic coryza without ozena, both Löwenberg's bacillus and the pseudo-diphtheritic bacillus were found. It is at once evident, therefore, that the ozenic nature of an atrophic rhinitis cannot be dependent upon the presence of the Löwenberg or Belfanti organism. More recent observations upon the frequent occurrence of bacilli resembling the diphtheria bacillus in conditions which are non-diphtheritic, such as stomatitis, cancrum oris, and ulcerations of the skin, must tend to diminish the importance of the same organism in cases of ozena.

Bayer² and others are in favor of the view that ozena may have a nervous origin—that we have, in fact, to deal with a tropho-neurosis. Bayer has invariably found Löwenberg's bacillus to be present, but he has seen it, also, in chronic nasal and post-nasal catarrh where there was no odor. The excellent results obtained by interstitial electrolysis appear to him to afford further proof of this view. The organisms are, he considers, superadded. As to the cause of the tropho-neurosis, the explanation is more difficult; it must be looked for in the central nervous system, but here the domain of hypothesis is entered, as the whole question of tropho-neurosis still requires solution.

It must be admitted that, notwithstanding the labor that has been spent

¹ *Revue hebdomadaire de Laryngologie*, Bordeaux, October 9, 1897, No. 41.

² *Ibid.*, May 30, 1896, No. 22.

in this field of research, the origin of ozæna is still unknown. This brief sketch has been given here rather with the view of emphasizing this fact and of leading up to some of the more recent methods of treatment than with the intention of giving any complete history of the work that has been done.

The Treatment of Ozæna by Cupric Electrolysis. At the annual meeting of the Belgian Laryngologists and Otologists, held in Brussels on June 16, 1895, Cheval announced that he had cured 91 per cent. of his cases of ozæna by interstitial electrolysis. A brief analysis of the cases¹ records the following facts: 70 patients were cured after one sitting; 12 required several sittings; 3 were still under treatment; 1, a very severe case, improved but was not cured after six sittings, at intervals of fifteen days to three months; 2 had not showed any improvement, and 2 had not presented themselves a second time. Such results naturally gave rise to a certain amount of incredulity and stimulated in others a desire to make trial of this method. In the following year Bayer, of Brussels, who had hesitated in accepting Cheval's results, published his own experience with this procedure.² As the operation is described by him in considerable detail, his account of the *modus operandi* may be given. A constant current was obtained by means of carbon and zinc elements immersed in a solution of bichromate of potassium. To the positive pole a copper needle was attached, to the negative a platinum needle; these needles were insulated throughout, save for a small portion at their distal extremities. An instrument for measuring the number of milliampères employed, and a rheostat for increasing or decreasing the strength of the current, were attached to the battery. The nasal fosse having been cleaned, and local anæsthesia having been produced by the application of a 10 per cent. solution of cocaine, the patient sitting or reclining, the positive copper needle was introduced into the middle turbinated body beneath the mucous membrane; the negative platinum electrode was, in a similar way, passed into the lower part of the septum or into the outer wall of the inferior meatus. By means of the rheostat the electric current was gradually increased up to 10 milliampères. In some cases a minimum current of 6 or 8 milliampères was found sufficient, while the maximum did not exceed 15. Both needles were introduced into the same nostril, and it was not, as a rule, necessary to insert them into the opposite one. The duration of the sitting was from ten to fifteen minutes. During the sitting some of the patients complained of headache, pain in the ear on the corresponding side, and watering from the eyes, symptoms which sometimes lasted for several hours.

¹ *Revue hebdomadaire de Laryngologie*, Bordeaux, August 1, 1895. ² *Ibid.*, May 30, 1896, No. 22.

Variations in some of the details are described by others who have employed electrolysis. Thus, Cheval sometimes made use of a silver needle on the positive pole, while the negative was made of steel; and others, again, used copper and steel needles. The needles described by Brindel were from 10 to 15 centimetres in length, 5 to 6 centimetres being left free at the distal extremity, the main portion being insulated with caoutchouc. The intensity of the current varied in Cheval's hands from 18 to 30 milliamperes. In many cases the treatment applied to one nostril only, was confined to one sitting; in others, again, it was repeated after a week or a fortnight, the needles being introduced either into the same nostril or into the opposite one. Bayer found that a modification in the nasal secretion was the first change to be noted; the mucous membrane became vascularized, and the secretion, instead of being tenacious and ropy and of a grayish-white or grayish-yellow color, became liquefied. The crusts were no longer adherent and easily became detached, while the nauseating odor disappeared, sometimes on the very day of operating. In other cases, again, a state of chronic catarrh supervened, accompanied by a more or less copious secretion with or without fetor. Some cases were followed by a rapid restoration of the parts, while in others a chronic catarrh persisted. There were, at the same time, patients who did not improve much, the result depending on the gravity of the condition. Although the current was applied only to one nostril, a like improvement was noted in the other, and also in the naso-pharynx.

Many other observers record the same immediate improvement, and I have had opportunity of seeing rapid amelioration after one sitting, perhaps the most striking change being the disappearance of all odor from the first, along with the occurrence of a general moist condition of the mucosa which enabled the patient readily to remove the secretions by means of a handkerchief. Does any permanent benefit result? Can any of these cases be regarded as genuine cures? A distinction must be drawn between the disappearance of the leading symptoms and an actual restoration of the parts. Brindel,¹ whose experience is based upon the treatment of thirty patients by this method, has admitted that the improvement which followed in all was not maintained for a long time. In ten of these cases, neither odor nor crusts could be perceived at the time of writing; they had been under treatment as follows:

- 1, eleven months previously.
- 3, ten months previously.
- 1, nine months previously.
- 1, eight months previously.
- 2, seven months previously.

¹ *Revue hebdomadaire de Laryngologie*, Bordeaux, August, 1897, Nos. 34 and 35.

1, five months previously.

1, three months previously.

Of these, two only could be looked upon as cured, in that the atrophy no longer existed, save on a small area on the inferior turbinate in one case. The remaining eight, while free from fetor and crusts, still showed marked atrophy of the turbinated bodies, and sticky mucus, which required the help of nasal irrigation daily to expel it, remained disseminated throughout the nasal fossæ. Of the twenty others, in spite of repeated applications of the electrolysis, seven had derived no advantage, while the remaining thirteen, while certainly benefited, were very far from being cured.

Rethi, of Vienna, who has expressed considerable enthusiasm at the success of electrolysis, submitted eight patients to this form of treatment,¹ and found that even in old-standing cases better results were obtained than by any other means which had been tried. At a meeting of the Vienna Laryngological Society, held on December 2, 1897, he presented a patient so treated, whom he had shown nine months before suffering from typical ozæna. Electrolysis had been twice applied; there was now no odor, and the mucous membrane was glossy, with here and there a slight secretion. For nine months Rethi had never used plugs, had never irrigated nor sprayed the nose, and the result obtained was better than by any other method. Rethi understood the term ozæna as meaning a nasal affection characterized by a peculiar odor, and when the odor disappeared he considered the ozæna cured. It was natural that this statement should arouse dissension, and both Ghiari and Hajek objected to the affection being described as cured when no change had taken place in the existing anatomical conditions, but merely a modification in the odor. It is all the more necessary, in view of such statements as that of Rethi, that too much reliance should not be placed on the so-called cures. Hendelsohn² has published the details of ten cases similarly treated, and he found that in the majority of them there was undoubted improvement, both subjectively and objectively, while the treatment lasted, but that after its cessation the cases again relapsed; one patient, however, whose case was clinically regarded as mild, at the end of five months had no evidence of crust formation or of fetor.

McBride,³ at the meeting of the British Medical Association held in Edinburgh in July, 1898, presented two cases of typical ozæna, one a girl aged seventeen years, the other a woman thirty years of age. The former had had three applications of cupric electrolysis nearly a year before, the latter two applications in August, 1897. In both there was

¹ Wien. klin. Rundschau, 1897, No. 10.

² Monatschrift für Ohrenheilk., Berlin, August, 1897, No. 8.

³ British Medical Journal, London, October 22, 1898.

an entire absence of odor and but little tendency to crust formation, though the parts still remained atrophic. Both patients had occasionally had recourse to syringing, but at the time of their exhibition the girl had not done so for three months, and the woman had not for more than a fortnight.

Cheval and Bayer, in the papers already referred to, have dealt with the rationale of this procedure. Chemical analysis of the coating deposited upon the copper needles has confirmed the observations previously made by Gautier and Javier, that an oxychloride of copper is formed. This salt, soluble in the lymph plasma, can penetrate the intercellular spaces, and can act not only at the seat of its production, but at some considerable distance from it. There is thus an actual diffusion of the salt so formed. Does this salt act as a germicide, or has it some other specific action? It is interesting to observe in the analysis of the cases reported by Bayer that where a microscopic examination of the mucus was made after electrolysis, when crusts and fetor had disappeared or become very considerably modified, Löwenberg's bacillus, in diminished quantity, and other microbes were found. Bayer and others find in the improvement which follows further proof of the existence of ozæna as a tropho-neurosis. Without violating any fact, what is there to prevent us, he asks, from regarding the electric current as a powerful nerve stimulant which acts on the sensory nerve terminations in the nasal mucosa? There is a reflex motor trophic impulse, the first effect of which is to bring about an increased vascular activity which is followed by all the local changes in the mucous membrane which have been already described. As the nasal mucus approaches more and more to the normal, it becomes a less suitable soil for the development of micro-organisms, which finally disappear altogether with the return of the secretion to its natural state.

Whether the cause of ozæna is to be found in one or more micro-organisms or in a trophic nerve disturbance, and whether improvement is consequent upon actual destruction of these organisms or from regenerated trophic influences in the first place, the fact remains that in interstitial electrolysis we have an undoubted beneficial agent in the treatment of ozæna.

Treatment by Injection of Diphtheria Antitoxin. In consequence of the assertion made by Belfanti and Della Vedova, that a bacillus identical with the bacillus of Loeffler was the cause of ozæna, subcutaneous injections of antidiphtheritic serum were employed by these observers,¹ and thirty-two patients were treated in this way. About thirty injections were made, the operation being repeated every other day, or, where possible, each day. The number of injections necessarily varied

¹ Loc. cit.

with the age of the patient, with the duration of the affection, and according to the local and general reaction which followed in each individual case. As a result of this form of treatment there were produced turgescence and congestion of the nasal mucosa, disappearance of the characteristic odor, liquefaction of the exudation, and disappearance of the crust formation. The rapidity with which these changes took place and the amount of improvement obtained varied in the different cases. Such complications as were known to supervene in the treatment of diphtheria by antitoxin were also met with, but they were neither grave nor dangerous. When such occurred, the authors advised the discontinuance of the injections until these symptoms had passed off. Among the Italians further investigations have been carried out, and Gradenigo,¹ Arslan, and Catterina² found that improvement followed the use of the serum. They were obliged, however, to state that after the lapse of a little time the same distressing and disagreeable symptoms again manifested themselves. Compaired,³ of Madrid, has expressed considerable satisfaction with this remedy. Molinié,⁴ of Marseilles, has detailed at considerable length the treatment of three girls who had suffered for some considerable time from true ozæna. There was atrophy in the nose together with an extension of the condition into the pharynx. Previous treatment had not produced any beneficial effect. Antidiphtheritic serum was then employed, sixteen injections in all being given to the first patient, nineteen to the second, and seven to the third, somewhat alarming general symptoms having supervened in the last case. At the end of five months—that is, three months after the last injection had been given—the first patient presented all the signs of a cure, the turbinated bodies presented a normal appearance, there were no crusts in the nose or naso-pharynx, and not the least odor was perceptible. No nasal irrigations were employed. The second patient, who was also examined about five months after the commencement of the serum treatment, and in whom the last injection had been made three months previously, was looked upon as cured. Examination of the nasal fossæ raised no suggestion of old atrophy, though some adherent mucus of a putty-like nature was found upon the left middle turbinated. In the third case, at the end of one month, the secretion had become quite modified and there was no trace of fetor.

The latest contribution to the serum treatment comes from the pen of Mygind,⁵ of Copenhagen. He treated altogether ten cases of genuine ozæna, all of which occurred in patients under twenty-two years of age.

¹ *Ann. des Malad. de l'Oreille, du Larynx, etc.*, Paris, August, 1896, and June, 1897.

² *Rev. hebd. de Laryng.*, Bordeaux, October 17, 1896, No. 42.

³ *Ann. des Malad. de l'Oreille, du Larynx, etc.*, May, 1897.

⁴ *Ibid.*, April, 1897.

⁵ *Journal of Laryngology*, London, August, 1898.

He found that 10 c.c. for adults and 5 c.c. for children formed a sufficiently large dose, each c.c. containing about 100 antitoxin units. There was an immediate and marked effect upon the nasal mucous membrane, and such changes as have already been described were seen to take place. No other treatment was employed. The patients were observed from three to eight months afterward, and he had no hesitation in pronouncing upon the value of this agent. Certain complications arose in the form of skin eruptions and joint affections.

What is there in the antidiphtheritic serum to bring about such modifications in the symptoms of *ozena*? Have we not in the serum treatment a means of stimulating the nasal mucosa to a more healthy condition similar to that produced by electrolysis? Mygind is now of the opinion that the presence of the toxins is of no importance, but that it is the serum alone which acts. In order to establish evidence upon this point he is now treating *ozena* patients with the injections of normal serum of horses, and we shall await with interest the publication of his experiments in this direction.

Treatment by Other Means. While so much attention has been paid by rhinologists to cupric electrolysis and injections of antidiphtheritic serum, other remedies have been used with more or less success. Eitler¹ employs a watery solution of ichthyol: a 2 to 5 per cent. solution is first sprayed into the nose after it has been thoroughly cleaned out, and thereafter the nasal mucous membrane is painted with a 25 per cent. solution of the same remedy. He has also found ichthyol of great value in pharyngitis sicca, and he believes that the favorable action of this drug lies in the fact that it prevents the destruction of the albuminous constituents of the body. Moure,² of Bordeaux, in concluding his interesting report to the French Society of Laryngologists and Otolologists on the treatment of *ozena*, details the method which he himself employs. In the first instance the crusts are removed and the nose is thoroughly cleansed by means of intranasal injections and the use of a wool carrier impregnated with carbolyzed glycerin. The patient is then given his choice as to whether he will merely have the nose kept clean or will submit himself to a more regular treatment. If he should choose the former procedure, nasal and retro-nasal irrigations with lysol, resorcin, or some other antiseptic are used, followed by a spray of menthol dissolved in oil. On the other hand, should continuous treatment be carried out, after the douching the nasal mucosa is massaged with a solution of iodine or with carbolyzed glycerin solution of the strength of 1 to 15 or 1 to 10. This massage is followed by washing out the nose and by the use of a spray of nitrate of silver

¹ Monatschrift f. Ohrenheilk., Berlin, November, 1896.

² Revue hebdomadaire de Laryngol., July 17, 1897, No. 29.

varying in strength from 5 to 25 per cent. A final injection of an alkaline lotion removes the excess of silver nitrate. Bathing the ale of the nose and the lips with a weak solution of iodide prevents any staining of the skin with the silver. The séance is repeated every other day for the first fortnight, then twice weekly for about a month, and, finally, at longer intervals according to the result obtained.

HAY FEVER.

The introduction of any remedy calculated to cure or even relieve this distressing affection would be gladly welcomed by those who yearly suffer from it. In view of the qualities of orthoform as a safe local anæsthetic, Lichtwitz¹ has employed it in hay fever and obtained good results from its use. He used it in three cases by insufflating the powder into the nasal cavities. One of his patients, a man thirty-four years of age, had suffered acutely for six years, and after one insufflation not only was the crisis cut short, but the trouble apparently disappeared altogether, as no fresh attack had occurred three months later. Such a favorable experience certainly differs from my own, as both personally and in the case of others for whom insufflations of orthoform were prescribed, no relief was obtained. A smarting sensation was produced by the particles of powder coming in contact with the sensitive mucosa, and a fit of sneezing was thereby induced. It is possible that its application in the form of a spray, combined with rectified spirit, might prove more serviceable, but I have not as yet experimented with it in this form. On the evaporation of the spirit the powder would lie in contact with the mucous membrane. It has been shown, however, that orthoform is very sparingly soluble in water, and unless brought into actual contact with nerve endings, as upon an ulcerated surface, it proves to be a very feeble local anæsthetic.

H. L. Swain,² of New Haven, found that an aqueous extract of suprarenal gland produced certain effects when used locally in the upper air passages; he has tabulated these as follows:

1. Aqueous extract of suprarenal capsule is a powerful local vasomotor constrictor and a contractor of erectile tissue; it is safe to use in a very considerable amount without dangerous or deleterious effects locally or as regards the general constitution.
2. These effects can be produced any number of times without entailing any vicious habits either in the tissue or in the individual.
3. It seems to heighten the effects of any drug used locally after it.

¹ Archives Internat. de Laryng., January and February, 1898, vol. xi.

² New York Medical Record, May, 1898.

4. In acute congestions it has its widest application and greatest opportunity for good, but in certain chronic conditions of the hay-fever type, when redundant tissue seems prone to develop, it can be relied on.

Solomon Solis-Cohen,¹ himself a martyr for many years to hay fever, has recently tried suprarenal substance, giving up all other remedies during its use. He found the treatment entirely successful in controlling the symptoms, and satisfactorily proved this by taking the medicine during one period and obtaining relief, while, after omitting it for a longer or shorter period, he found that the symptoms returned. He first used a glycerin extract of sheep's suprarenal glands, freshly prepared and made more palatable in the form of an elixir, 15 drops to a teaspoonful, the dose being repeated thrice daily; later he found it necessary either to increase the dose or to repeat it more frequently. As a tendency to nausea arose, he substituted the tabloids prepared by Burroughs & Wellcome. One tabloid, containing 5 grains of suprarenal substance, was allowed to dissolve in the mouth every second, third, or fourth hour, according to the effect produced. On an average he took five tabloids daily, the last one being at bedtime, with the result that the night passed without his having any of his symptoms. If an attack of sneezing and watery discharge commenced, he found that it ceased within fifteen minutes after taking a tabloid. In the light of the results obtained by Solis-Cohen, further experience in the use of this drug will be welcomed.

NASAL HYDRORRHOEA.

Bosworth, in his well-known work on *Diseases of the Nose and Throat*, described, under the term nasal hydrorrhoea, an affection of the nose which he regarded as a disease *per se*. He collected and published eighteen cases which he considered to be examples of this condition. St. Clair Thomson,² of London, has carefully investigated the cases collected by Bosworth, and has come to the conclusion that only three of them justify the application of the term "nasal hydrorrhoea." At the last meeting of the British Medical Association, held in Edinburgh, St. Clair Thomson communicated an instructive paper³ upon this subject. He suggested that this term should not be employed if the profuse nasal discharge was dependent upon any intranasal pathological changes, such as hypertrophies, polypi, septal spurs, new growths, etc., or when the fluid was cerebro-spinal or originating in the accessory sinuses, or was

¹ Philadelphia Medical Journal, August 13, 1898; and epitome, British Medical Journal, 1898.

² Transactions Medico-Chirurgical Society, London, 1898, vol. lxxxii.

³ British Medical Journal, London, October 22, 1898.

part of some general nervous affection such as trigeminal neuritis. If the flow of secretion, while moderate in quantity, was accompanied with sneezing, photophobia, etc., and of a paroxysmal nature, it should then be described as a variety of that affection known under the various terms of hay fever, vasomotor rhinitis, or nervous coryza. The clinical picture presented by nasal hydrorrhoea shaded off in one direction into those cases which were generally called hay fever, with symptoms of intense local irritation, while in the other direction a passive and almost painless watery discharge from the nose was the clinical type which manifested itself. These cases were further characterized by an absence of any visible pathological change in the nose, by its being an affection apparently of middle life, and by affecting both sexes indifferently; while the watery discharge might be more marked upon one side than the other, as a rule it took place from both nostrils, and handkerchiefs when soaked with it, generally dried stiff. An analysis of the fluid from one of Thomson's cases was made by Professor Halliburton, and the following report was furnished: "The fluid is thick and viscid and slightly opalescent; on microscopical examination it shows the usual appearance presented by mucus, namely, amorphous matter with mucous corpuscles. It gives with acetic acid, and also with alcohol, a stringy precipitate like that given by mucin. On boiling this precipitate with dilute sulphuric acid a reducing sugar-like material is formed; this also is characteristic of mucin. The fluid contains a small amount of proteid coagulable by heat; it does not reduce Fehling's solution. Proteoses and peptone are absent. The alcohol extract of the fluid contains no reducing substance. Analysis gives the following results:

Water	98.792	) per 100
Total solids	1.208	
Proteids (including mucin)	0.260	
Other organic substances	0.063	
Inorganic substances	0.785	

"The presence of mucin and absence of reducing substance, as well as the percentage of proteids and solids, are quite sufficient to distinguish this fluid from normal cerebro-spinal fluid."

Thomson drew special attention to the importance of differentiating those cases where the nasal watery flow was really an escape of cerebro-spinal fluid. Cases of cerebro-spinal rhinorrhoea were distinguished by the fact that the discharge was limited to one nostril, unless there was some obstruction on the affected side, when it made its way round to the opposite nasal fossa. Handkerchiefs soaked with it dried soft, and could be used again without washing. It was frequently associated with headache or other mental symptoms which were relieved by the discharge. It was not accompanied by lachrymation, and sneezing was rare. Along

with Prof. Halliburton he had drawn up the following table of chemical tests for the detection of cerebro-spinal fluid :

1. The fluid is perfectly transparent like water, and contains no sediment.
2. It is faintly alkaline in reaction, and either tasteless or slightly salty.
3. The specific gravity is between 1005 and 1010.
4. It is not viscous and gives no precipitate (mucin) on adding acetic acid.
5. On boiling there is not more than a trace of coagulum of serum-globulin and serum-albumin.
6. Cold nitric acid gives a precipitate which disappears on heating and separates again on cooling.
7. Saturation with magnesium sulphate should give a precipitate. Saturation with sodium chloride should also produce a precipitate. Ammonium sulphate should be tried if the above salts fail.
8. The liquid should give a pink or rose-red color with a trace of copper sulphate and excess of caustic potash.
9. When boiled with Fehling's solution there should be a reduction of the copper.
10. The reducing substance may be obtained by evaporating to dryness an alcoholic extract of the fluid. It is then found in the form of needle-like crystals.
11. The aqueous solution of this residue does not ferment with yeast.

Cresswell Baber,¹ of Brighton, has given an account of a case of chronic watery discharge from the right nostril of a lady, forty-two years of age. Her previous history revealed the fact that on two occasions she had had a polypus removed from the same nostril, the first having been removed after eight months of excessive watery discharge following influenza. The secretion then ceased, but after a second attack of influenza it again returned, and five months later a second polypus was removed. When the patient came to be examined by Baber there was nothing complained of but a profuse, non-fetid, watery discharge from the right nostril, continuing day and night. The mucous membrane of the right nasal fossa was sodden in appearance, but there was no polypus; there was nothing to suggest any affection of the antrum; there was no loss of sensation in the distribution of the trigeminal nerve in that nostril. The fundus was normal in both eyes. An examination of the discharge revealed the presence of organic solids containing mucin, proteids, and certain undetermined constituents; the inorganic solids, sodium chloride and calcium phosphate, were also present, the former in such a proportion as closely to approximate the normal saline fluid. The case was

¹ Transactions London Laryng. Society, January 12, 1898.

probably one of excessive secretion from the nasal mucosa, a case to which the term nasal hydrorrhoea might aptly be applied. It was possible that the polypi resulted from a constant irritation of the mucous membrane induced by the abundant flow of secretion.

Treatment. Baber found the application of the continuous current to either side of the nose, externally, most beneficial, and after repeated applications the discharge gradually ceased. St. Clair Thomson emphasized the fact that treatment was somewhat empirical, and that in one case a cure followed, while in another nothing but failure resulted. It is most important that careful general treatment, hygienic, dietetic, and climatic, should be insisted upon. Chappell,¹ of New York, and Jankelevitch,² of Bourges, have both expressed the opinion that the affection sometimes arises in consequence of malarial poisoning, and have advocated the use of quinine in treatment. Chappell has recorded four cases in which cure followed the administration of this drug.

FIBRINOUS RHINITIS.

The subject of fibrinous or membranous rhinitis possesses special interest on account of the presence, in these cases, of a bacillus indistinguishable from the diphtheria bacillus. Are these cases to be distinguished clinically from mild cases of nasal diphtheria? It is an affection of the nose characterized by the presence of a membranous exudation which is confined to the nasal fossie, and which contains the Klebs-Loeffler bacillus. It does not, as a rule, give rise to general constitutional symptoms, and it is marked by an absence of paralytic sequelae. An interesting discussion on this subject followed the reading of a paper by Lambert Lack³ before the Royal Medical and Chirurgical Society of London. Lack found this nasal condition present in no less than 2.5 per cent. of all the children attending his hospital practice, and he briefly analyzed the symptoms which manifested themselves in thirty-six cases. It occurred essentially in children and most frequently during the autumn months. Locally, there were nasal obstruction and discharge, with consequent excoriation of the nostrils and upper lip, and occasional epistaxis; sometimes sore-throat was present. The local symptoms lasted, on an average, from six to eight weeks or more, so that they were of a chronic nature. General symptoms were very mild and altogether absent sometimes. There was no paralysis. Bacteriological examination of the membrane, in thirty-three patients, gave results of special interest. The true Klebs-Loeffler bacillus was constantly present, generally in pure culture

¹ New York Medical Journal, September 29, 1894.

² Revue hebdomadaire de Laryngologie, No. 51, December, 1897.

³ The Lancet, London, October 29, 1898.

and sometimes mixed with pyogenic cocci. The bacillus was usually of the large variety, its identity being proved by its morphology, by its growth on various culture media, by its being virulent on animals and producing toxins, and by its being capable of neutralization by antitoxins. The surroundings of the patients were examined, all sources of diphtheria sought for, and all those with whom the patients had come into contact were examined both clinically and bacteriologically. A previous history of diphtheria was found in connection with one case only. The disease, however, appeared to be infectious in that it gave rise to similar appearances in others. Laek found, further, that the diphtheria bacillus existed in the throats of healthy persons who had been associated with these cases of fibrinous rhinitis, and in addition it was also found in the healthy noses of different individuals. He came to the conclusion that fibrinous rhinitis was a mild variety of diphtheria, the difference in the clinical manifestations depending, apparently, on some differences in the organisms associated with the Klebs-Loeffler bacillus.

T. D. Lister stated, in the discussion which followed, that he had examined 125 children, of whom 69 had nasal discharge of varying quality, while 56 were free from anything of the kind; 37 of the former and 24 of the latter presented the Klebs-Loeffler bacillus, and in 5 cases where the discharge was more or less blood-streaked the bacillus was found in all.

C. Todd¹ demonstrated the presence of a bacillus, morphologically indistinguishable from that of diphtheria, in discharges from the anterior nares of 51 children convalescing from scarlet fever—*i. e.*, in 15 per cent. of the cases which he had examined. The children affected with this rhinitis, which was confined to the nasal vestibule, had not been exposed to any extent to infection from cases of diphtheria during their stay in the hospital. Although there occurred 51 cases of rhinitis in which this diphtheria-like bacillus was present, only one case of diphtheria was met with. In these cases the rhinitis was not membranous, and was unaccompanied by rise of temperature, albuminuria, or marked glandular enlargement. The bacillus was not found in the fauces. When inoculated into guinea-pigs it proved to be virulent.

Grenet and Leone² have conducted a series of experiments to ascertain the connection of various cases of purulent coryza, unaccompanied by false membrane, with true diphtheria. The majority of the cases of coryza examined occurred in children under one year of age, and in a large number of them a very small bacillus, smaller than the short diphtheria bacillus, and often curved in form, was discovered. This grew

¹ The Lancet, London, May 28, 1898.

² Archives de Méd. des Enfants, August, 1898 (see epitome, British Medical Journal, October 29, 1898).

longer when cultivated in suitable media, but it never attained the dimensions of the long form of diphtheria bacillus. When inoculated into the rabbit it caused death eight times in sixteen experiments. As the result of inoculations, two varieties of bacilli were distinguished as existent in the nasal cavities of these children: (1) A bacillus of which either the pure culture or the toxin proved fatal, giving rise in the animals inoculated to lesions entirely analogous to those produced by the classic variety of the diphtheria bacillus. (2) A bacillus very difficult to distinguish from the first variety, having the same essential form and character, but which was not fatal to the animals inoculated. The two varieties were sometimes met with in the same subject.

The facts noted in these various papers are of extreme interest. They prove the presence in nasal discharges of bacilli resembling, in more than one characteristic, that bacillus which is looked upon as the etiological factor in diphtheria. Nevertheless the symptoms of true diphtheria do not manifest themselves. We appear to have two distinct clinical types with an apparently similar bacteriological factor present. Three cases recently reported by Middlemass Hunt,¹ of Liverpool, tend to show that it is not always possible to distinguish clinically between the two diseases. In one case a medical man had suffered for two weeks from membranous rhinitis affecting both nasal passages and unaccompanied by any constitutional symptoms. In the third week of the nasal trouble he developed pharyngeal diphtheria, followed by paralysis. A little girl, with membrane in both nasal passages, but otherwise in good health, was found to have had pharyngeal diphtheria with paralysis six weeks before. In this case no Loeffler bacilli were found in the membrane. Lastly, a girl, aged ten years, had left-sided nasal obstruction with false membrane, lasting for eight weeks. There was no albuminuria, no enlarged glands, no sore-throat or general symptoms, and no paralysis. In the same house a servant had an attack of "tonsillitis" followed by paralysis of the palate, and a baby died of croup. The perusal of such cases as these gives rise to a difficulty in distinguishing, clinically, fibrinous rhinitis from mild nasal diphtheria.

It would not be out of place here to quote some of the remarks made by so distinguished a pathologist as Kanthack, of Cambridge,² on the presence of diphtheria bacilli: "Bacilli, resembling diphtheria bacilli but not Hofmann's bacilli, are found with great frequency in many forms of ulceration of the skin, gangrene, stomatitis, cancrum oris, and noma. . . . I hope soon to find the necessary leisure to publish my own researches, but wish to point out here that in many forms of chronic and impetiginous ulceration of the skin it is easy to find bacilli resembling

¹ Journal of Laryngology, London, October, 1898.

² The Lancet, London, May 28, 1898. At the conclusion of Dr. Todd's paper.

the diphtheria bacillus in all respects excepting virulency ; I see no reason to separate them as pseudo forms. . . . The diphtheria bacillus is, in my opinion, widely distributed, frequently in modified forms, it is true, but still in such forms which, except by artificial and imaginary criteria such as would not be recognized in the case of other micro-organisms, cannot be separated from the Klebs-Loeffler bacillus. . . . The diphtheria bacillus is found in many lesions which are not 'diphtheria,' and the various tests generally enumerated do not suffice to distinguish the various modifications from the text-book variety of the Klebs-Loeffler."

THE NASAL ACCESSORY SINUSES.

Howard and Ingersoll,¹ of Cleveland, have carried out an elaborate investigation into the etiology of inflammations of the accessory sinuses, both by microscopic and culture methods. The material was obtained from eighteen cases of sinus inflammation, no opportunity, however, having arisen for procuring any from the sphenoidal sinus. Cover-slip preparations were studied, cultures were made on blood-serum and on agar-agar plates, while the pathogenesis of nearly all the micro-organisms found was determined by inoculation upon rabbits and guinea-pigs. The conclusions arrived at by the authors from the facts thus obtained were : first, that acute and chronic inflammations of the accessory sinuses are not caused by a single micro-organism nor even by a single group of micro-organisms, but by those which are commonly present in the buccal cavities in health, and in the nasal cavities occasionally in health but more usually in disease. The chief organisms were the diplococcus lanceolatus, the pyogenic staphylococci and streptococci, the bacilli of the group of Friedlander's bacillus, and the diphtheria and influenza bacilli. Secondly, they were led to observe that the accessory sinuses might be invaded by a direct extension of the inflammatory process from the nose in various conditions, such as rhinitis, influenza, diphtheria, tuberculosis, syphilis, nasal tumors, erysipelas, and injuries, and in pharyngitis and tonsillitis ; in others, again, the affection arose when parts of the body remote from the sinuses were primarily involved by such conditions as erysipelas, articular rheumatism, pneumonia, phthisis, etc.

Antrum of Highmore. Herzfeld,² of Berlin, uses rubber plugs in cases of antral suppuration : these are conical in shape and taper toward the end which passes into the antral cavity. The lower end is made to rest upon a broad but thin sheet of rubber, which is cut out so that the adjacent teeth fit into it, and thus prevent the plug from slipping up into

¹ The American Journal of the Medical Sciences, May, 1898.

² Monatschrift für Ohrenheilk., January, 1898.

the cavity. The broad end of the cone may be 8 mm. in diameter, while the narrow end is 2. It is necessary that the plug should be of sufficient length to pass through the whole depth of the artificial opening, because the inner or antral end of the track may become blocked by the growth of new bone unless the patency is preserved. The length of the plug is about 3 cm. It may be introduced immediately after the operation. Somewhat similar plugs are made for introduction through an opening in the canine fossa.

Meyjes, of Amsterdam, describes, in the same journal, a tube provided with a metal collar fixed at right angles to its lower end in order to prevent its passing up into the antral cavity. In this collar a hole is bored through which a piece of silk is passed, and this in turn is tied around the crown of the neighboring tooth, or, should no suitable tooth be present, the tube is fixed to a dental plate. By an ingenious arrangement this tube is provided with a small lid which protects its buccal extremity. By means of a hinge this lid can be opened or closed, its margin projecting beyond the circular metal collar, so that the patient's finger-nail can be inserted and the lid thus raised. On the deep or inner surface of the lid is a small elevation, which accurately fits the lumen of the tube, and thus closes it more securely. By both these methods an attempt is made to prevent reinfection of the antrum from the mouth.

Although considerable progress has been made in recent years in the surgery of the accessory sinuses, there is still room for further advance, both in our methods of diagnosis and of treatment. It is evident that merely to open, wash out, and drain a cavity with rigid bony walls lined with granulation tissue and polypi, and possibly affected with areas of carious bone, cannot be efficient treatment. While better access may be obtained and more thorough treatment applied to the lining membranes by making a large opening through one of the osseous walls, it is still found that many obstinate cases of suppuration remain incurable. Where the whole lining membrane of the cavity has been removed, healing and cicatrization are often considerably delayed because the surface growth of epithelium and the growth of granulations do not take place *pari passu*.

In order to increase the line of growth of the epithelium, and to admit of a more equal development of granulation tissue and fresh epithelial covering, Bönninghaus,¹ of Breslau, resected the osseous nasal (or inner) wall of the antrum, and then invaginated the nasal mucous membrane into the cavity; in this way half or more of the sinus becomes covered with previously existing mucous membrane, while the remainder is covered in by fresh epithelium which grows from the edge of this and

¹ Archiv für Laryngol., Berlin, 1897, Bd. vi. Heft 2.

from the opening in the mouth. In operating for this purpose he first removes the outer wall of the antrum, after turning up the buccal mucous membrane, and the interior of the cavity is then scraped if deemed necessary. The second part of the operation consists in resecting the nasal wall; this is done from its outer or antral aspect with the aid of a good light. The operator recognizes, by palpation, the line of junction between the lower and more bony part of the wall and the upper more membranous part; this line corresponds to the attachment of the inferior turbinate bone, and by means of the chisel and forceps the bone lying below this line is removed, due care being taken not to injure the nasal mucosa upon its other surface. The anterior and upper corner, where the tear-duct lies, should not be interfered with. The nasal mucous membrane, which now forms the only partition between the nasal fossa and the antrum, is invaginated into the latter and kept in position by means of strips of iodoform gauze which are introduced through the nose; at the same time, however, care is taken to keep the nose as free as possible for respiration. The cavity of the antrum is also plugged from the mouth. After four or five days the gauze tampons are removed from the nose, as the mucous membrane by this time has become adherent in the antrum. The wound in the mouth is treated by plugging, and through it the cavity is syringed morning and evening.

At the meeting of the French Society of Otology, Rhinology, and Laryngology, held in Paris in May, 1898, Luc¹ related certain modifications which he had made in the treatment of maxillary empyema. He made his incision as high as possible in the fold formed by the cheek and the alveolus. A large opening was then made through the outer wall of the antrum, and the interior scraped by means of specially bent curettes, so that no aspect of the cavity might be overlooked. An artificial opening was next made through the inferior meatus of the nose anteriorly, and through this the cavity was drained with iodoform gauze, the mucous membrane of the mouth being carefully sutured. This procedure, however, had been previously adopted by Caldwell.

The Frontal Sinus. Operations upon this sinus, through an external opening, are daily becoming more frequent. The condition found in chronic empyema of the frontal sinus is similar to that so frequently met with in the antrum, and it is impossible to deal with granulation tissue and polypi through the intranasal route. It is necessary, therefore, to open the sinus through the skin by one or other of the incisions recommended for that purpose. These cavities vary very considerably in their dimensions, showing great irregularity not only in different skulls, but on the two sides of the same skull, so that the extent of the operation

¹ Ann. des Malad. de l'Oreille, etc., Paris, June, 1898.

varies in different individuals. Logan Turner,¹ of Edinburgh, has examined seventy open sinuses in macerated skulls, and has measured each in three diameters. A sinus with the following measurements may be looked upon as one of average size: Height, 34 mm., from the fronto-nasal aperture vertically upward; breadth, 30 mm.—*i. e.*, from the septum horizontally outward; depth, 17 mm.—*i. e.*, from the anterior wall at the level of the fronto-nasal suture backward along the orbital roof. The smallest sinus met with extended outward to the junction of the inner and middle thirds of the supra-orbital margin, and measured in height 19 mm., in breadth 14 mm., in depth 5 mm. The largest, on the other hand, bounded internally by a mesial septum, was limited externally by the bony wall of the temporal fossa, while it extended along the roof of

FIG. 10.



FIG. 11.



the orbital cavity as far as the anterior edge of the optic foramen; it had the following dimensions: height, 43 mm.; breadth, 60 mm.; depth, 47 mm. (See Figs. 10 to 15.) The greatest vertical diameter that was met with was 53 mm., the cavity extending upward on to the forehead for more than two inches. Perfectly symmetrical sinuses were never met with when the measurements were carefully studied. In all the skulls examined, with one exception, the bony septum between the sinuses was found complete, and in the majority of cases it occupied a mesial position. The question of the obliquity of the septum is not without practical interest to the surgeon. Its deviation may be of such a nature as to render him liable to make a mistake as to the exact pathological condition present. In two of the skulls examined the septum lay so close to the supra-

¹ Edinburgh Medical Journal, April and May, 1898.

orbital margin of one side, reducing one sinus almost to a slit, that it would have been extremely difficult, if not impossible, for the surgeon to realize that a second cavity existed there. It would be probable in such a case, therefore, that with suppuration in the smaller sinus, the larger healthy sinus would be opened into if the chisel were applied to the anterior wall, thus giving rise to a misconception in diagnosis and

FIG. 12.



FIG. 13.



FIG. 14.



FIG. 15.



to a mistake in treatment. The two small cavities in both of these skulls communicated with the nose through a fronto-nasal aperture. The frontal sinuses are not always simple chambers, for partitions, sometimes incomplete, sometimes complete, are occasionally found, and in this way pockets and diverticula may be formed. Turner found in one skull the right sinus absent, while the left was divided into two by a complete

vertical bony septum. Again, horizontal septa may divide a sinus into an upper and a lower cavity, each communicating by a special aperture with the nose. In every instance the sinus was found to communicate with the nose, though the size of the opening varied considerably, from a mere slit to an orifice measuring 7 by 8 mm.

Bryan, of Washington,¹ has drawn attention to the group of air-cells lying between the frontal sinus and the ethmoidal cells. In preparations which he examined he found that the number of these air-cells varied from four to seven on each side, but he was unable to find any communication between them and the frontal or ethmoidal cells proper. They may be unusually developed and project into the frontal sinus to a considerable extent. In treating chronic suppuration of the frontal sinuses attention must be paid to the condition of these cells, for if they are simultaneously affected, as they so frequently are, they may become the source of reinfection of the sinus.

Another interesting anatomical point, with important clinical bearing, is the relation of the infundibulum or fronto-nasal duct to the opening into the maxillary antrum. Bryan has demonstrated a preparation in which the frontal sinus communicated directly with the antrum by means of a groove found just in front of the hiatus semilunaris, while Fillibrown,² of Boston, found that the infundibulum, instead of terminating in the middle meatus, continued as a half tube which terminated directly in the opening of the maxillary sinus. In seven heads examined there was a fold of membrane which served as a continuation of the unciform process, and this formed a pocket which would prevent any frontal sinus secretion from passing into the middle meatus of the nose until the antrum was full to overflowing. Milligan,³ of Manchester, on several occasions found in mixed cases of sinus suppuration—that is to say, where both frontal and maxillary cavities were affected—that fluid syringed into the antrum came out at once into the opening in the forehead, and *vice versa*. There is no doubt that the relation between these two cavities is an intimate one, either directly, as just indicated, or through the medium of the fronto-ethmoidal and anterior ethmoidal cells. So close a relationship explains, in many cases, the difficulty in effecting a cure in chronic suppuration of the antrum, reinfection taking place from the disease in its immediate neighborhood.

Logan Turner, in the paper already referred to, deals at some length with transillumination as an aid in the diagnosis of frontal sinus mischief. Experiments were made upon macerated skulls and endavera, and upon living subjects with both healthy and diseased sinuses.

¹ British Medical Journal, London, November 13, 1897.

² International Dental Journal, January, 1897.

³ The Lancet, London, February 19, 1898.

Kuhnt's observation as to the possibility of defining the extent of this cavity by illumination was repeatedly proved upon crania, while it was shown on cadavera that the soft parts diminished the intensity of the transmitted light, but did not interfere with the accurate mapping out of the sinus. It was further shown, both in the crania and in the case of healthy living persons, that the intensity of the illumination not only varied considerably in different skulls and individuals, but on the two sides of the same skull and of the same head. The amount of variation may be very slight; in more than one case, while illumination was evident upon one side, it was absent upon the other, even though a second sinus was proved to exist.

In cases of frontal sinus suppuration it was found that in one individual a cavity containing pus and granulation tissue allowed the rays of light to pass through, while in another complete opacity existed. The conclusion drawn from all these observations was, that as a means of diagnosis in frontal empyema, transillumination did not yield very reliable results. From the point of view of treatment, however, it proved of more service. If a diseased sinus was illuminated, its limits, both vertically and horizontally, were defined; its size could be thus indicated, and an opening made into it without any risk of entering the skull beyond it. If, on the other hand, the diseased sinus proved negative to illumination, the method still had a useful application, because if the opposite, healthy sinus became illuminated, the position of the septum could be defined, a point of no small value when the variations in the position of this partition are remembered. It was found possible, also, to define the outer limit of one or both sinuses when diseased and negative to illumination. It was observed that when the lamp was gradually carried outward below the supraorbital margin, a point was reached where illumination of a limited area immediately above the eyebrow occurred. This evidently took place through the somewhat thin bone forming the outer part of the supraorbital margin. That the junction of light and darkness was the external limit of the sinus was proved by an examination of skulls in which the sinuses were, in the first place, illuminated and their external limits defined; after stuffing them, and thus rendering them impervious to the rays, the lamp was again carried outward beneath the supraorbital margin, and the point at which the thin bone allowed the rays to penetrate was found also to be the external limit of the sinus.

Milligan¹ has had special opportunities of studying chronic frontal sinus suppuration from its clinical aspect. Of 15 cases operated upon by him, 14 were chronic, while 1 was acute. As a proof of the partici-

¹ Loc. cit.

pation of one or more of the neighboring sinuses in the suppurative process, he found that in 11 more than one sinus was affected; in 13 cases the suppuration was unilateral; in 2 cases bilateral. Of 5 cases of right-sided frontal empyema, it was found that the maxillary sinus of the same side was affected in 2, and the ethmoidal cells of the same side also in 2 cases. Of 12 cases of left-sided frontal empyema, it was found that the maxillary sinus of the same side was affected in 5 cases, and the ethmoidal cells of the same side in 5 cases. In both the cases of double frontal empyema, suppurative ethmoiditis was also present. In one case of right frontal suppuration, the left maxillary antrum was affected, while in one case of left frontal empyema, both maxillary antra were involved. An operation through an external opening is indicated, he considers, when: (1) there is retention of pus within the sinus, unrelieved by simple and intranasal methods, as leeching, irrigation, etc.; (2) a purulent discharge persists from the region of the sinus after the exclusion of the participation of the other accessory sinuses in the production of the discharge; (3) there are present symptoms of cerebral irritation or of cerebral compression; and (4) in the presence of severe neuralgic pains with the accompanying impairment of general health.

In all his cases he employed the vertical mesial incision, and preferred the chisel and mallet to the trephine saw when dealing with the bone. Free drainage through the nose he considered a necessity, and this was carried out by removing a portion of the floor of the sinus with a gouge or sharp spoon, thus, at the same time, breaking down the ethmoid cells and liberating in part the associated ethmoidal suppuration.

OTOLOGY.

By ROBERT L. RANDOLPH, M.D.

ANATOMY AND PHYSIOLOGY.

THE region of the labyrinth still continues to be the birthplace of theories. Its workings in health, though probably simple like those of all wonderful mechanisms, are perplexing enough to stir up strife between such men as Breuer¹ and Von Cyon.² The title of Von Cyon's article (*Die Functionen des Ohrlabyrinths*) would lead one to expect a great deal that was valuable, but we look in vain for what is new, and find scarcely more than a polemic. It will be remembered that Helmholtz was the first to suggest that there existed in the labyrinth two localities, each having its peculiar function, one—the cochlea—for the perception of musical tones, the other—the vestibule and ampulla—for the perception of noises. This theory, however, has been subjected to not a little divergent criticism, especially at the hands of Mach, Brücke, Exner, and others, so that the so-called Helmholtz theory of 1863 stands to-day in some respects modified.

It is, no doubt, well known that efforts have been made from time to time to reconcile what is known of the embryology of certain parts of the ear with the various hypotheses as to the functions of those parts, but only in a very limited degree can such an interdependence be established. It is now assumed that the cochlea fibres can equally transmit the perception of tones and noises, and a recent observer (Hammerschlag³) in an interesting communication endeavors to prove the truth of this assumption by recourse to embryological facts.

In making a cross section through the cochlea of a vertebrate embryo, the first thing that strikes us is the fact that the cochlea canal, at a certain stage in its development, was a simple epithelial tube surrounded with mesodermic connective tissue having a very slightly differentiated epithelial layer. The floor of this tube corresponds to what later becomes the membrana basilaris, while the roof is afterward known as the membrana Reissneri; but even at an early stage the epithelial layer of the floor differs from that of the roof in that in the former there exist very minute nerve fibres arising from special clumps of cells. In this stage

¹ Pflüger's Archiv, Bd. lxxiii.

² Ibid., Bd. lxxi.

³ Archiv für Ohrenheilkunde, Bd. lxiv. Heft 2.

neither the scala tympani nor the scala vestibuli is present, the first appearance of these occurring at a period when the epithelium of the cochlea has reached advanced differentiation. Only through the gradual completion of the scala tympani and scala vestibuli does the floor of the cochlea become the membrana basilaris and its roof the membrana Reissneri.

It must again be assumed that the cochlea represents a brief epitome of the philogenetic development of this organ, and hence we are justified in concluding that the cochlea, with its canal, represents a permanent condition at some point in the animal series. At this stage it seems certain that the function of the cochlea was to transmit the perception of auditory stimuli; this being the case, only such auditory stimuli could be appreciated as require for their perception an irregular and relatively strong concussion of the entire canal, and such an irregular concussion of the neural epithelium along this canal corresponds to the physical substrata of a noise, and can never lead to the representation of a musical tone. Granted this as proved, it is clear that the function of the cochlea of vertebrates, at some stage in the animal series, was for the perception of noises, and that this animal lacked entirely the capacity for recognizing tones. Going on still further in the development of the ear, we learn that the floor of the cochlea canal, with its neural epithelium, assumes physical characteristics by reason of which it can transmit the perception of musical tones. The author refers here to the component fibres of the membrana basilaris. It is well known that the developmental process in the case of the two scalas of the cochlea follows a direction from below upward—*i. e.*, from base to apex of cochlea, and, according to the "recapitulation theory," the animal under consideration would gradually attain to the perception of high tones, and in the regular course of events to the perception of low tones; further, as we have seen, the membrana basilaris possesses the capacity of being thrown throughout its entire extent into irregular vibrations, a capacity which it must have retained after its final completion. It may be said, in conclusion then, that regular vibrations of parts of the membrana basilaris give us the conception of musical tones; irregular concussions of the entire membrane, or large areas of the same, result in the sensation of distinct or definite noises.

Apropos of the subject of the cochlea, mention should be made of a contribution by Ayers¹ on the membrana basilaris, membrana tectoria, and the nerve endings in the human ear. According to the latest observations of this author the basilar membrane consists of four layers of fibres, three of which run radially, while the fourth, which may be

¹ Zoölogical Bulletin, May, 1898.

divided into an upper and a lower layer, runs at right angles to these three. The important layer of spiral fibres is most apparent upon the upper surface of the basilar membrane. The basilar fibres are direct products of connective-tissue cells of the embryonic basilar membrane. For the most part these fibres are simple, but some of them are branched. As regards the auditory cells, these are cylindrical in shape, the inner row being so short that they are almost ovoidal, and are surrounded by the modified non-nervous cells of Corti's organ. The hair cells are much shorter than the supporting elements. The hairs arise from the top of each cell as a slender bundle, the fibrils growing from all parts of the cell cap. Each cell bears, on an average, two dozen filamentous flexible hairs which sweep inward from the cell to end free in the endolymph above the limbus spiralis. The whole hair floats in the endolymph, and all the hairs are so closely placed that they exert a capillary attraction on one another, so that when loose from the tops of the cells they remain adhering in the form of a ribbon, called the *membrana tectoria*. The long hairs are the percipient elements in the cochlea instead of the connective fibres of the basement membrane of the same organ.

The author concludes his observations by speaking of the nerve endings in the ear. The regular nerve fibres, on reaching the ganglion cell, issue from the peripheral border of the cell as a single fibre (bipolar cell), or as several distinct fibres (multipolar cells), all of which make their way to the organ of Corti. These fibres sometimes do not follow their radial course, but pass at right angles to their former course. All nerve fibres leaving the cochlea ganglion reach the organ of Corti, where they terminate in the bases of hair cells or in a subacoustic nerve net, from which fibres are given off to the hair cells. Ayers has not observed any interepithelial or free nerve ends, though these may occur. His investigations were made on the ears of three human embryos and of two adult males.

Dr. Paul Manasse¹ describes cartilaginous interglobular spaces in the capsule of the human labyrinth. The subject is not an entirely new one, for Böttcher, Moos, Politzer, and others have made somewhat similar observations. Manasse, though, has brought forward more than one new point. The cavities were large and ramifying, embedded in the bone, always in the vicinity of the cochlea turns, and filled throughout with hyaline cartilage. In other words, he found in the osseous labyrinth two systems of canals, one a system of bloodvessels, and the other a system of cartilage-bearing spaces, each with a distinct bony wall. They are present till late in life, while in other bony structures they are only met with in bones of the fetus or in those of very young children. The

¹ Archives of Otology, October, 1898.

author gives a very minute description of these areas, and concludes his contribution with an explanation of the histogenesis of the osseous bodies of the labyrinth and of the bone corpuscles of the interglobular cavities.

I think it will be found that in operations upon the mastoid those who know most thoroughly the anatomical conditions of this region will, in the long run, have the best results. It is true that cleanliness may cover

FIG. 16.



FIG. 17.

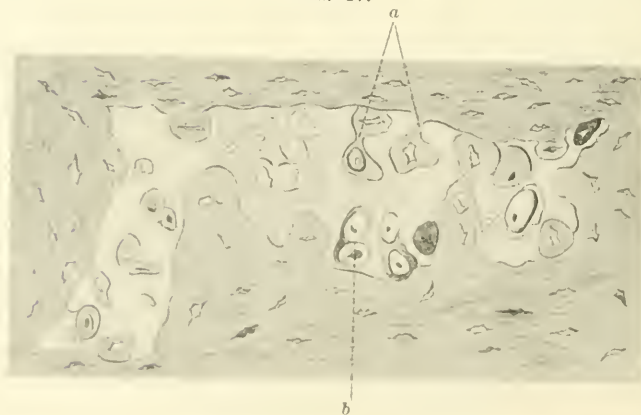
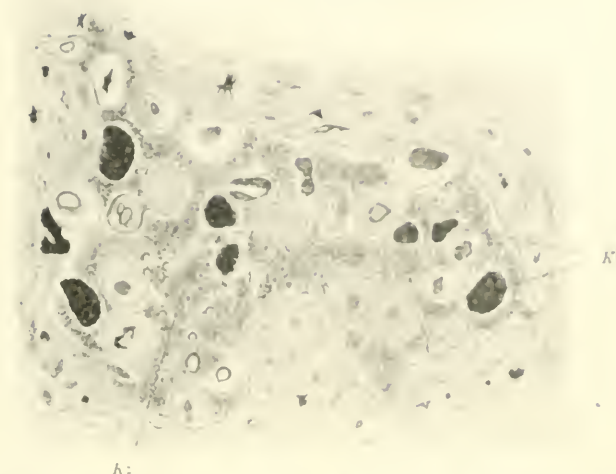


FIG. 18.



Kz

Kl

Cartilaginous interglobular cavities in capsule of the labyrinth. (MANASSE.)

Fig. 16. From cochlea of man, aged forty-seven years. *J*, Interglobular cavities containing cartilage.

Fig. 17. From cochlea of an adult. Interglobular cavity highly magnified. *a*, Osseous pedicles. *b*, Cartilage cells, with osseous surrounding.

Fig. 18. Ground specimen (not decalcified). *Kz*, Cartilage cells. *Kl*, Granules of lime salts in matrix.

or compensate for many shortcomings in one's knowledge of the surgical anatomy of the mastoid, but ignorance of just those minute anatomical details which Randall¹ has recently emphasized might render a surgical procedure, to say the least, fruitless. Often the mastoid is opened, and nothing abnormal, or at least intelligible, is revealed to our eyes, simply because the trouble may be lurking in the secret places, so to speak, and not in the grosser areas. I have seen this again and again, and fortunate it is that we know how to supplement ignorance by precautions against infection.

Our anatomical knowledge is constantly being enriched, but contributions having a decidedly practical quality are of more than usual importance. Randall has called our attention to the venous channels of the aural region. It is not to be understood that the big sinuses are here meant, for their importance has always been recognized and their location is, of course, not an unfamiliar one. We are invited to consider the smaller and what might seem to some the insignificant channels. Each of these emissaries, however, has its part to play in disease as well as in health, and no doubt each in some way is always concerned in the ultimate result of an operation. It is well to know that the inferior

¹ Journal of the American Medical Association, March 26, 1898.

petrosal sinus "receives countless twigs from the interior of the temporal bone, and can easily be the recipient and transporter of much septic matter." It is well to bear in mind the fact that in the back of the temporal bone there is danger of wounding what is known as the mastoid emissary, and again, the cavernous sinus at the tip of the pyramid is not infrequently "involved in caries of the extremity of the temporal bone." Here, too, are numerous pneumatic cells communicating with the antrum and abounding in venous twigs.

The author's investigations do not show that there is much diploëtic structure in the mastoid process, though we would be led to infer the contrary from the work of Zuckerkandl. The needlessness of opening such wide areas of diploë is dwelt upon. That we multiply thereby the dangers of a general infection is almost self-evident. Noteworthy also are the minute bloodvessels dipping into "the bone with the offshoots of fibrous tissue from the dura mater, most marked at the petrosquamous suture and the subarcuate fossa." In both of these localities septic infection has been known to occur.

The results of the observations of Cajal, Monakow, Kölliker and others have served to throw much light upon our knowledge of the central termini of the labyrinthian root. These observers do not entirely agree in their conclusions. Some adhere to the opinion of Edinger, admitting that a certain number of fibres of the vestibular root terminate in the cerebellum, forming, with the fibres belonging to the other sensorial nerves, the sensorial bundle of Edinger. Edinger has returned to his first opinion and regards the connection between the vestibular root and the cerebellum as an indirect one and brought about through the intermediary of the nucleus of Deiters.

Opinions differing from these views in more or less degree are entertained by other observers. Within the past few months an anatomical study has been made by Thomas¹ on the dog. The results are as follows: The cochlea root terminates in the lateral nucleus—that is to say, in the ventral ganglion of the acoustic and in the acoustic tubercle. A certain number of the fibres which terminate in the ventral ganglion become detached and penetrate the trapezoid body. The straight fibres terminate in the superior olivary body and in the juxta-olivary nucleus of the same side. The cross fibres pass over the median line and terminate in the superior olivary body, in the juxta-olivary nucleus, and in the nucleus of the trapezoid body. Some of the fibres after leaving the lateral nucleus pass backward from the trapezoid body and traverse the descending root of the fifth and the nucleus of the facial. The sections did not show satisfactorily whether or not the nucleus received fibres from the cochlea root.

¹ Comptes-Rendus Hebdomadaires, etc., Février 18, 1898.

The vestibular root penetrates higher than the acoustic root, its inferior fibres passing across the restiform body, and its uppermost fibres crossing over the descending root of the fifth. According to Cajal, the root separates into two branches, an ascending and a descending branch. The former is the shorter and is distributed to the nucleus of Deiters and of Bechterew and to the triangular nucleus of the acoustic. The descending branch can be followed to a point within the nucleus of Monakow. Some of the fibres disappear in the lower extremity of Deiters's nucleus and partly in the lower extremity of the triangular ganglion. It may be said in summing up these results that they go far toward confirming the observations of Cajal in this direction.

It will be remembered that attention was called to the fact that more or less obscurity surrounded our knowledge of the functions of the different parts of the labyrinth. To a somewhat less extent we are in the dark when we come to explain the functions of the tensor tympani muscle. Exactly what part this muscle plays in hearing has been fruitful of much speculation, and even to this day widely differing opinions prevail. Some have assigned to this muscle, as well as to the stapedius, the capacity of exciting movements, being nothing more than elastic bands which serve to heighten the stability of the chain of ossicles, while others believe that both of these muscles are for the purpose of protecting the delicate inner structures against too powerful sound waves, while there are those, again, who hold that these two muscles are for regulating the tension of the tympanic membrane; in other words, a sort of accommodation apparatus.

In this connection may be mentioned an experimental study by Ostmann¹ on the reflex excitability of the tensor tympani muscle. This observer goes over the whole subject, reviewing the works of Hensen, Bockendahl, Brücke, Hermann, and others. His first series of experiments were made on dogs, and were for the purpose of determining whether, under the influence of different kinds of sounds, movements of the drum membrane could be observed, which movements could be referred to the action of the tensor. This was usually accomplished by intracranial irritation of the fifth nerve, after first rendering the nervous system of the dog exceedingly sensitive to sounds by feeding him for several weeks on gradually increasing doses of strychnine. All sorts of noises and tones were utilized in the experiments—the different notes of the violin, of the human voice, whistling, the report of a pistol, etc. These experiments were repeated in the clinic. The results in both series were suggestive, showing that sounds of peculiar pitch and intensity give rise to reflex movements or twitchings of the drum membrane. On the other hand, tones and noises within certain limits were attended

¹ Archiv für Anat. u. Physiol., 1898, Heft 1 u. 2.

with apparently no movements of the membrane. The movement is described as being extremely delicate, quick, and localizing itself at and around the malleus handle.

The conclusions of Ostmann are practically these: The tensor tympani muscle serves as a protective apparatus for the ear. When the latter is in a condition of rest the muscles act by confining or limiting the width of the vibrations, the result being that we hear with the minimum amount of sensation—that is to say, we hear with no sense of discomfort. This protection seems to suffice for relatively great amplitudes of sound vibration. The muscle also prevents all excessive outward movements of the hammer and drum membrane, doing so in a natural way, and to a certain extent acts as the antagonist of the stapedius muscle. The contraction of the tensor protects the ear by rendering difficult the conduction of sound vibrations through the sound-conducting apparatus. Reflexly, the contraction is produced by peculiar kinds of noises intense in character, and, much less frequently, by very high tones.

The development of Corti's membrane, its anatomical characteristics, and its relations to other parts of the cochlea have been made the themes of innumerable dissertations. The most recent work on the embryology of this membrane is by Czinner¹ and Hammerschlag. The investigations were made chiefly on the ears of embryo guinea-pigs in the various stages of their development, also on the ears of cats and rabbits. The fact will be recalled that Kölliker was the first to suggest that Corti's membrane was an epidermis formation and that it represented a product of excretion from the epithelium which lines the ductus cochlearis. This opinion was generally accepted, and the work of Czinner and Hammerschlag has only served to strengthen this view.

These observers have shown that Corti's membrane in its earliest stage (in the case of the embryo guinea-pig) consists of a row of very fine fibres springing from the upper wall of the inner angle of the canal of the cochlea. Czinner and Hammerschlag regard these fibres as belonging to the innermost zone of Corti's membrane (in opposition to Kölliker and Böttcher, who hold different views as to its relations to surrounding parts), and as taking their origin at a point, in the embryonic canal of the cochlea, corresponding to the location of the future labium vestibulare cristæ spiralis. This zone, then, is the foundation, so to speak, and from it the remainder of Corti's membrane develops. At a certain period there occurs an extensive epithelial union or binding between the under surface of Corti's membrane and the upper surface of the papilla spiralis. In this way the membrane is ultimately joined to the other nervous structures in this locality. Finally, as regards the division of Corti's mem-

¹ Archiv für Ohrenheilkunde, Band lxxiv, Heft 1.

brane, the authors distinguish only two zones, one an inner, which, as has been said, rests upon the *labium vestibulare cristae spiralis*, and an outer zone which has its origin from the inner one. It will be remembered in this connection that Böttcher and others distinguish three and even four zones, so that in this particular, to say nothing of other minor points, the work of Czinner and Hammerschlag does not entirely agree with the conclusions of others.

THE MIDDLE EAR.

Chronic aural catarrh is certainly the bane of nearly every otologist's practice, and there is probably no disease to which the flesh is heir which is more discouraging to both physician and patient. The surgical treatment of this affection does not seem to have found so general favor among American and English otologists as among the French. Miot especially has done a great deal of work in this line, and is an enthusiastic advocate of surgical procedures under certain circumstances. This aspect of the subject has recently been brought forward anew and a plea made for the more frequent adoption of surgery in the treatment of certain forms of aural catarrh. There seem to be, however, conditions which contraindicate its use, as, for instance, where there are hereditary degenerative processes, or where there is present either great age or gout. Again, in atrophic sclerosis with an extremely thin drum membrane, and where there is hyperemia of the promontory, operative measures seem to be useless. On the other hand, the hearing for the watch (by bone conduction) must be absolutely intact, and the C and A forks must be heard better on the diseased side than on the other. In those cases where both the Valsalva and Politzer methods are distinctly beneficial one can advise operation with a reasonable hope of success. According to Moure¹ and Monnier, the result of an exploratory paracentesis of the drum membrane should be the strongest factor in determining us whether or not to operate. If a paracentesis be made and the patient feels an improvement, we can always count on more or less benefit from the operation. The operation, Moure thinks, should preferably be done through the external auditory canal.

The operation consists in removing the drum membrane and all the ossicles except the stapes. In those rare cases in which the anatomical conditions are such as to make it difficult to remove the incus or to see the stapes, it will be necessary to chisel away the upper posterior portion of the *margo tympanicus*. The author takes a decided stand against the retro-auricular opening. He seems to think that, if anything, the retro-

¹ Archiv für Ohrenheilkunde, Band lxiv, Heft 3.

auricular opening tends to bring about acute congestion, hemorrhage into the vestibule, to say nothing of infection from without. Furthermore, the opening soon becomes filled up with adhesions of connective tissue which lay bare the entire tympanic cavity. It must be remembered that improvement in hearing and disappearance of the tinnitus do not always happen at the same time as a result of this operation. Sometimes the hearing is improved and there is no change in the tinnitus, and then, again, the reverse may happen. As yet it is too early to decide upon the permanency of these results. They may be only transitory.

In this connection mention should be made of a case reported by Alderton,¹ where the foot-plate of the stapes was trephined in order to improve the hearing, but the result of the operation was absolutely negative. Jack, Blake, and others report cases where the stapes was removed, but, with the exception of Jack, no one has seen benefit follow the operation.

Chronic Suppurative Inflammation. Kretschmann² has recently given us a tabular statement of operations upon the ossicles for chronic suppurative inflammation of the middle ear. His first series consisted of fourteen cases, and in thirteen of these the malleus and incus were removed, simply to put a stop to the discharge, while in the remaining case the same operation was performed to improve hearing. The otitis media was cured in eight of the thirteen cases. He reports, in addition to these thirteen cases, other cases where the malleus alone was removed for the same cause. In this series eight were cured, and in three of these it was shown that the malleus was normal. Further on he reports forty-two cases where the radical operation was performed in order to remove the ossicles. No results are given in this series.

All of his conclusions in regard to the pathology of caries of the ossicles, the special predisposition of certain bones to caries, the points on the different bones which are peculiarly liable to caries, are practically in accord with previous conclusions of others. Worthy of note, however, is the fact that there are only two cases reported of isolated disease of the incus. Five cases of cicatrization of carious defects are reported, and among these one of the incus. As regards the pathogenesis of suppurative processes in the attic, which processes so often lead to caries of the ossicles, Kretschmann thinks that in a number of cases an acute inflammation probably never existed, but that a so-called chronic inflammation was present from the start.

In speaking of therapy he does not seem to regard operative measures as the only means which we have at our disposal. Such measures should

¹ Transactions of the American Otological Society, 1898.

² Klinische und pathologische Beiträge zur Caries von Hammer und Amboss, Festschrift zum 50 jährigen Jubiläum des Magdeburger Aerztereins, 1898.

be resorted to only when other methods have failed. If conservative methods fail he removes the malleus in the manner recommended by Schwartze. For removing the incus he uses an instrument which is not unlike that employed by Ludwig—a blunt spoon fixed at right angles to the shaft with the concavity looking backward. Kretschmann's method of operating, his treatment generally, and his conclusions are practically in accord with those of Schwartze and his pupils. There is much that is valuable in the monograph, and the author undoubtedly makes it clear that there are cases of chronic suppurative inflammation of the middle ear where the removal of malleus and incus will bring about a cure. It is to be regretted that in the present state of our knowledge we are unable to differentiate those cases which are specially suitable for the operation, in which the latter can be at once resorted to, without first having to lose time over conservative methods of treatment.

It cannot be said that extracting the hammer and anvil has proved to be as valuable a measure for the cure of suppurative inflammation of the middle ear as we had hoped it would, not because the operation has fallen short of expectations, but because most have hesitated to adopt a treatment so radical. At any rate, the operation has not been weighed in the balance and found wanting. That this procedure promises a great deal goes without saying, but it is doubtful whether it will ever be practised to any great extent. Passow¹ gives his views on this subject. Of course the aim in this operation is to expose the middle ear so that all diseased areas, however small, may be reached. As regards the retro-auricular opening, which has many opponents, it must be said that this step certainly simplifies the after treatment, for every spot is open to tamponage, niches large and small are easy to see and secondary operations easy to do. In both Koerner's and Pause's operations there are decided shortcomings. In making the radical operation Passow insists that the patient shall either remain under his own care or that of another aurist.

Some have claimed that the frequent dressings which are necessary in the radical operations are particularly painful with the retro-auricular opening. Real pain, says Passow, is an indication of genuine disturbance, and is not a necessary adjunct to the method by any means. After the operation a large bandage is needed, especially when the cavity remains open for a considerable length of time. If we wish to let the wound close we should not resort to pedunculated flaps, but to Thiersch's method. If we tampon from the meatus only, the wound will close rapidly, and that is exactly what we do not wish to happen. We cannot, he says, choose the time at which we can abandon the retro-auricular

¹ Archives of Otology, June, 1898.

opening and its advantages. The time it takes for recovery, or, in other words, how long it will be before cicatrization occurs, depends upon the plastic method employed. The average duration of time needed for recovery from the radical operation, as performed by some twenty operators, is from three to four months. The opening itself should be as small as safety permits. Large orifices are not only disfiguring, but

FIG. 19.

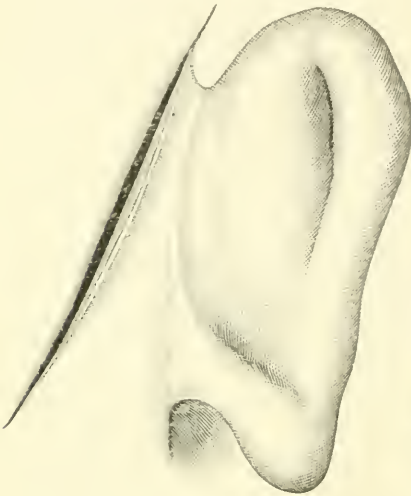


FIG. 20.

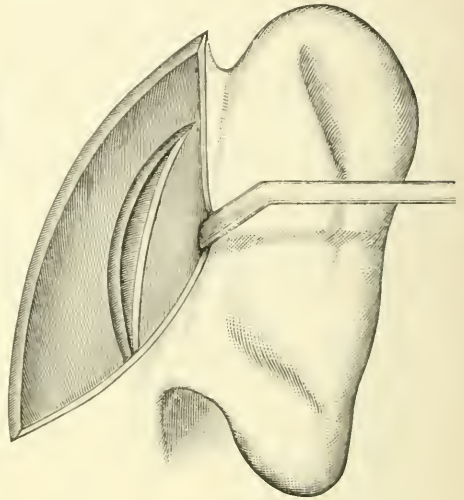
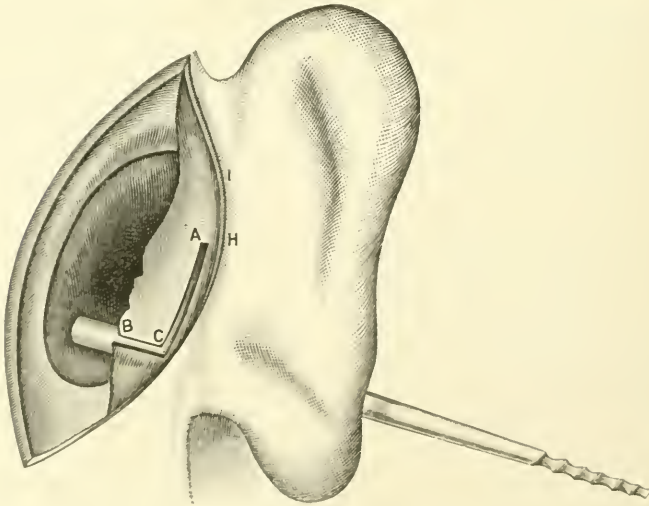


FIG. 21.



dangerous because they may give rise to relapses. The formation of epidermis is more certain and rapid if we leave the opening chiefly to its own recovery. In chronic affections of the mucosa, or in caries, there

is no necessity for keeping the opening persistent, but the author gives the timely advice not to close it until the epidermis is everywhere formed. In cases where there is a cholesteatoma Passow closes the fistula if the skin has remained smooth and free from irritation for six months or possibly a

FIG. 22.

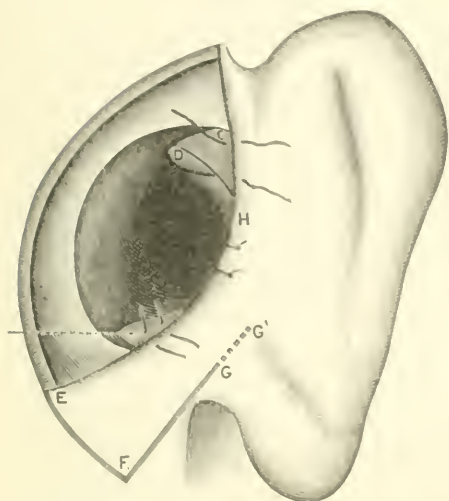


FIG. 23.

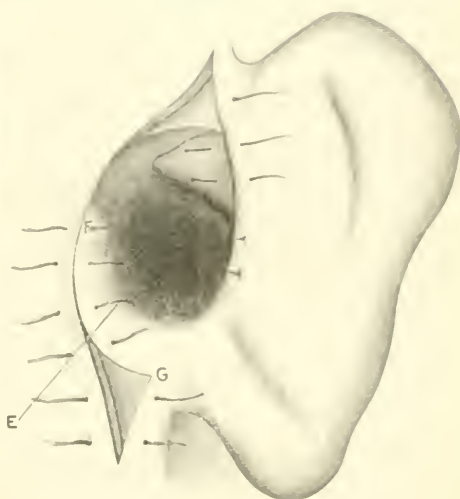


FIG. 24.

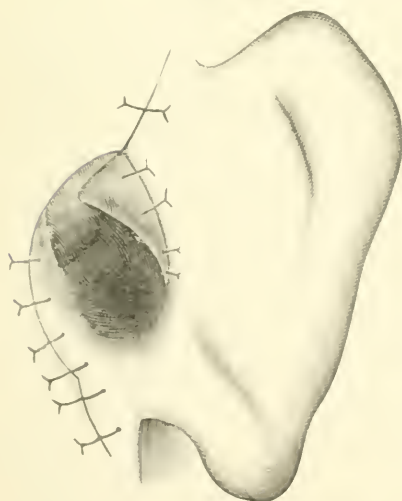


FIG. 25.



year. If eczema remains on the cicatrix, if superficial layers of epidermis exfoliate, or if there be a tumor extending into the antrum, the opening is allowed to remain. Passow reports fifty-four radical operations, but of these the after-histories of only forty-four are traceable. There was one case of relapse and three of occasional eczema. It is much better to

FIG. 26.

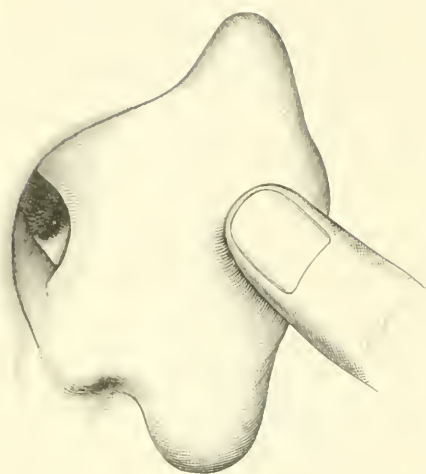
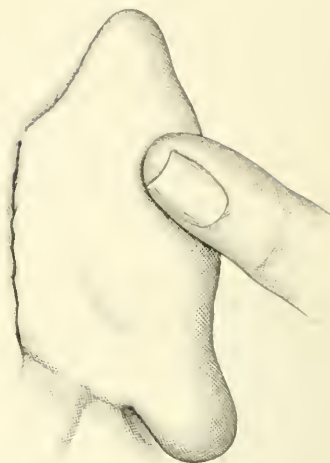


FIG. 27.



The retro-auricular opening. (PASSOW.)

Figs. 19, 20, 21, 22, 23, and 24 show the retro-auricular opening from the beginning to the end of the operation. Figs. 25 and 26 show the condition seven months after the operation. Fig. 27, scar after closure of the opening.

let the fistula exist for too long than too short a time, and an important factor in deciding this matter is the width of the meatus. For a detailed account of the operation reference should be made to the original.¹

Infectious Sinus Thrombosis. The literature of the past year is teeming with accounts of operations performed on the mastoid, operations for intracranial abscesses, meningitis, and sinus thrombosis, complications which follow, as a rule, chronic suppurative inflammation of the middle ear. A survey of this literature would convince the most skeptical of the danger which is always associated with otitis media suppurativa. A contribution in this connection by Frederick Whiting,² of New York, is of exceptional interest and value, not only because of the author's rather unique experience in the successful treatment of three cases of pyemic sinus thrombosis, but because of the complete clinical description of this affection based on the most careful study. The author reviews the subject historically, and enumerates the symptoms.

He regards the edema of the region of the occipital vein with marked tenderness on pressure in the upper portion of the post-cervical triangle (Griesinger's symptom), and the diminished flow through the external jugular (Gerhardt's symptom) on the affected side, as the symptoms most to be relied upon, and symptoms which, when present, should at least justify "operative investigation." The advice of Hessler, to operate only

¹ Zeitschrift für Ohrenheilkunde, Bd. xxxii.

² Archives of Otolaryngology, vol. xxvii. p. 1.

when the clot is an infected one, finds no supporters, for it is clear that in our efforts to find this out we would almost certainly infect the clot. Koerner, on the other hand, advises operation as soon as we know there is an obstruction, and in this opinion he is pretty generally upheld, for we know that the tendency of the thrombus is to become infected, break down, and end in metastatic emboli. Organization is probably exceptional.

As regards the method of operating, there are two methods—*with* and *without* jugular ligation. It is evident that of these methods the first has by far the greater number of followers, numbering on its side such men as Horsley, Zaufal, Macewen, Ballance, and others. Arrayed against these is principally Schwartze, who gives as his reason for not ligating the jugular that many cases have recovered without it. Tying one jugular does not guarantee that infective particles may not be carried into the lungs through the other; furthermore, the procedure increases the danger of hemorrhage, and, finally, it is often exceedingly difficult to find the jugular owing to surrounding cellular infiltration. Whiting then goes on to relate the histories of his three cases, from a study of which the following facts were brought out:

Excessive vomiting in this class of cases is usually regarded as strong evidence of the existence of meningitis, yet from the clinical history of two of the author's cases, it is clear that excessive and persistent vomiting may be present for days with sinus thrombosis without any coexistent meningitis. The appearance of peripheral metastases, after ligation of the jugular has closed the approach to the lungs, is a condition which has been noted by Whiting and others. Another point which Whiting regards as of the utmost importance is whether tenderness along the anterior border of the sternocleidomastoid muscle—which almost always indicates jugular phlebitis—may be simulated by inflammation of the deep lymphatics. Whiting thinks that this condition of the lymphatics only exists when there is already an infective phlebitis of the jugular, together with purulent disintegration of the clot in that portion of the vein lying very close to these lymphatics. Hence it would be dangerous to delay ligating under the supposition that the tenderness along the anterior border of this muscle is to be referred to glands inflamed from a remote septic focus, rather than from a place near at hand at the sensitive point in the neck. Resection of the jugular is advised when it has been tied in two places, and unless this is done some portion of the vein will suppurate and retard healing.

Sinus thrombosis more often affects men than women, and it occurs between the ages of twenty and forty years. The right side is more often involved on account of the structural peculiarities of the right temporal bone. Thus far 139 cases have been reported, and of these 95

ended in recovery and 44 in death. The author places his indications for ligating the jugular under two heads—*before* and *after* exposing the sinus. Under the first head the indications should be very decided, and are as follows: The existence of chronic otorrhea; marked symptoms of pyæmia, high fever, repeated rigors, and metastases; occipital œdema and œdema of the eyelids of the corresponding side; tenderness along the course of the jugular in the neck, and finally, neuroretinitis. *After* he exposes the sinus and recognizes the thrombus; but *before* opening it, the indications for ligature should be the presence of a clot extending well down into the bulb, disintegrated in its lower portion and associated with pyæmic symptoms; the display by the sinus of respiratory movements would render probable the admission of aërial embolism to the heart unless the vein were tied; when the sinus has been exposed and opened, ligation should be performed when the thrombus has undergone purulent liquefaction, for curetting under such circumstances is attended with great risk unless the vein is tied; finally, ligation should be performed when there is inability to reëstablish the circulation from below, whether the clot has or has not disintegrated.

Whiting¹ has lately given us, also, a detailed description of the technique employed for sinus thrombosis. In a case of suspected thrombosis where the site of the clot may be at or below the jugular bulb, he suggests the following procedure as having been in more than one case a valuable aid in exactly locating the thrombus. The blood was expressed from the sinus, along the axis of the channel, until it was empty and its walls semi-collapsed. This state of the vessel was kept momentarily by pressure at each extremity with either the finger-ends or gauze pads. It is clear that if the obstructing pressure were removed suddenly from one end of the devascularized channel, the latter would fill with blood, provided there was no obstacle to its entrance at the corresponding side, while if such obstacle existed the channel would remain empty. The procedure is as follows: The left index finger is placed across the sinus, at the bulb, with sufficient firmness to cause collapse of the walls at that point. The right index finger is then placed close beside the left, and with a stroking, stripping movement, carried steadily along the course of the sinus toward the torcular as far as the knee, at which point the finger rests with firm pressure. The result is to leave the walls of the sinus in a collapsed condition between the two controlling fingers. An assistant now makes firm pressure upon the jugular vein, low down in the neck, so that the backward pressure of the blood-current toward the bulb may be augmented as much as possible. If there is no obstructing thrombus present the collapsed walls of the sinus will at

¹ Archives of Otolaryngology, vol. xxvii. No. 6.

once become distended with blood on removing the pressure of either finger. In the case under consideration the finger making pressure at the bulb was withdrawn, but the sinus did not refill, showing conclusively that the obstruction existed at the bulb, or below, in the jugular vein. This method is designed especially for the detection of an obstruction situated at the bulb below a point where palpation can be practised with facility.

Whiting closes his article by emphasizing the value of intravenous infusion of twelve to twenty ounces of normal saline solution at a temperature of 110° F. He suggests its employment before the beginning of the operation as a prophylactic against shock when the case is one of pronounced sepsis. He thinks the importance of aspiratory puncture, as an aid to diagnosis, is very much overrated, and regards it as valuable simply as a confirmatory test, and, finally, "the operator should sacrifice every detail save cleanliness and thoroughness to the demands of time, a few moments more or less being important elements in a favorable or unfavorable termination."

Neuralgia of the Mastoid. "For all cases in which a purely neurotic origin can be assumed the operation of opening the mastoid (Schwartz) affords almost certain relief." This is the text of a portion of a contribution made by Sattler, of Cincinnati, to the surgery of the temporal bone. He is speaking of neuralgia of the mastoid, of that variety which is unaccompanied with demonstrable symptoms, and which baffles the remedies usually employed for neuralgia elsewhere.¹ This class of cases must be designated as purely hysterical in origin, its conspicuous clinical symptoms being pain, intense in severity, lasting for weeks, and located over the entire mastoid region, auricle, and external auditory canal. Such cases have no previous history of ear trouble, and differ in this respect from another group of cases which, although presenting the same kind of pain, give a history of having passed through an attack of inflammation of the middle ear, generally many years before. The first class of cases is the more interesting one, and no doubt the explanation given by Sattler of the beneficial effect of the mastoid operation is the correct one, namely, that surgery is a powerful measure of suggestion, or may we not say, a healthy and substantial substitution for the diseased imagination. It would be interesting to know whether this variety of cases is met with in males. All Sattler's cases apparently occurred in females. That the neurotic element enters as strongly into the sufferings of the second group, as the author seems to think, is not so clear. It would appear that the anatomical changes resulting from the old trouble in the middle

¹ *Loc. cit.*

ear would be sufficient to give rise to just such a train of symptoms as were observed in the first group of cases. This, in the light of what we know, is the explanation of the symptoms of other varieties of aural disease. He closes his very interesting discussion by attributing the relief which follows the mastoid operation to the latter being a "forcible measure of suggestion, or, possibly, it is the means of relieving morbid changes so slight that they cannot be discovered, and which cause a derangement of physiological relationship of function, innervation, and circulation of the pneumatic accessories of the middle ear."

Antrectomy. One of the most important papers read at the last meeting of the British Medical Association was by W. Milligan, of Manchester,¹ on antrectomy. The author takes the stand that too much time is consumed in the conservative treatment of suppurative inflammation of the middle ear, and that radical measures should be sooner resorted to. Milligan's experience and his rank in the otological world would at least entitle his views to respect, yet, while the report of his 150 mastoid cases is interesting and instructive, he has hardly persuaded us that it is proper to open the mastoid early in order to cure a discharge. By far the majority of chronic suppurative inflammations of the middle ear are curable by non-operative measures faithfully carried out, and it is hard to fix a limit when we can say that the time for the mastoid operation has come. We must confess that not infrequently the mastoid operation is followed by failure, even though the operation itself is not dangerous.

Milligan's rule is as follows: When suppuration has persisted for twelve months, and when, for at least three months, careful and rational local treatment has been tried and has failed, the mastoid antrum and cells should be opened and cleaned out. In cases of tuberculous origin we should make an early opening and institute drainage without attempting any prolonged local treatment. It cannot be said here that Milligan's advice is wise. Most cases of tuberculous otitis media are associated with tuberculosis elsewhere, either in the larynx or in the lungs, and it is not likely that under such circumstances any operation could be radical, while, on the other hand, it is more than probable that an operation of this character would aggravate the general condition unless the mastoid symptoms were very intense. Milligan also advises an early and radical operation when cholesteatomatous masses occupy the antrum and attic, and in such cases he favors the maintenance of a permanent mastoid fistula. He then goes on to analyze the 150 cases where he performed the radical operation, dividing his cases into three classes: acute, subacute, and chronic. In all the cases, with the exception of the tuberculous

¹ British Medical Journal, October 22, 1898.

ones, "persistent and careful local treatment had been employed for periods varying from twelve to twenty-four months, but without avail."

Stacke's operation was performed in 78, and of these 65 were completely relieved—that is to say, all suppuration ceased and the antrotympanic cavity became papered with an epidermal covering. In 72 the Schwartze method was employed, with 47 recoveries. The most interesting cases were, of course, the chronic, and of these there were 102.

As regards the hearing power of those who had been operated upon for chronic disease, the hearing, as a rule, remained about the same; in some cases it was made worse, and in others the hearing power for conversation was slightly improved. In conclusion, it must be said that Milligan's results, on the whole, afford strong evidence in favor of the operation.

Boric Acid. Boric acid finds a warm advocate in Prof. Steinbrügge,¹ who not long since reiterated the value of this product in the treatment of otitis media suppurativa. The most important points in Steinbrügge's essay are the claims which he makes for boric acid. We all know the value of this agent, for most of us employ it as a routine treatment in otitis media suppurativa. Steinbrügge first syringes out the ear with a solution of boric acid and, after drying the parts well, fills up the canal with the powder. It is well known that Schwartze and his pupils have taken a decided stand against filling the external auditory canal with powder. Steinbrügge agrees with Bezold in thinking that there is no danger, and that the pus which finds its way into the canal is quite sufficient to dissolve the quantity of acid present, and that the mass of powder acts like a sponge. He uses a balloon syringe, holding about 120 c.c. of water, and he dissolves a heaping tablespoonful of the acid in a tumbler of water as hot as the patient can bear it. The acid does not kill the bacteria which are present in the middle ear, but it prevents them from finding a suitable foothold and nutrition. The water must be boiled. The author uses this method in both chronic and acute forms, and continues its use until surgical methods are indicated. It must be said that the reviewer agrees entirely with the conclusions of Bezold and Steinbrügge, and that no disaster has ever come to his knowledge from filling the canal with the powder.

Taking the great mass of cases of suppurative inflammation of the middle ear, it is more than likely that boric acid, of all the remedies usually employed, will easily cure the greatest number and materially help the rest. It seems to possess less irritating properties than any of the remedies which we are in the habit of using in these cases, and to this virtue, in a large measure, must be attributed much of the success.

¹ *Zeitschr. für prak. Aerzte*, No. 5, 1898.

After a fair trial it is rather unusual to have failure, and any remedy which in such a case will effect a cure is a valuable addition to our armamentarium.

TRAUMATOL. Kraus¹ speaks of the various methods of medication for otitis media suppurativa, and reports four cases where boric acid had long been used in vain and where he had effected a cure within six days by the insufflation of traumatol (iodoeresyl). The ear is first washed out and dried, and the powder then blown in. This is repeated every day. The most significant thing about this report is that the boric-acid treatment had been employed without success in all of the cases. It does not follow, however, that the results in these four cases would indicate that traumatol was a superior remedy to boric acid in the treatment of this affection generally.

Tuberculosis of the Middle Ear. This subject has not received much attention during the past year, and while Winkler's² work adds little that is new, still the author has succeeded in giving us an interesting and detailed résumé of the clinical aspect of this affection. Indeed, we find here everything that is of any practical value in connection with the clinical history of tuberculosis of the middle ear. The work of others is thoroughly sifted, and to this he has added a few observations of his own.

The etiology of this disease is not perfectly clear. Where there is a perforation in the drum membrane infection can, of course, easily occur; but where there is no perforation infection, as a rule, occurs through the Eustachian tube, though it must be said that it is possible for organisms to be carried to this locality through the general circulation, and it can be easily understood that the disease is most often found where there is a general infection. Very rarely does it manifest itself primarily in the tympanic cavity, though Guranowski reports a case of tuberculosis of the middle ear where the ear symptoms appeared a long time before the involvement of the lungs. It is evident that tuberculous affections of the nose and throat can readily lead to tympanic infection through the Eustachian tube. In this connection Freudenthal has recently called attention to the fact that the discharge from what we regard as nothing more than an ordinary nasal catarrh not infrequently contains tubercle bacilli, and Straus has found the bacilli in what was apparently a perfectly healthy nose.

SYMPTOMS. As regards the symptoms of this variety of otitis media, we find that those usually present in cases of suppurative inflammation of the middle ear are lacking. At first a slight clouding and redness of the tympanic membrane may be present; on the other hand, even in an advanced stage of tuberculosis, the examination of this

¹ Allg. Wiener med. Zeitung, No. 12, 1898.

² Aerztliche Rundschau, viii. Jahrgang, Nos. 18-19.

membrane may reveal nothing. A point which distinguishes this variety of otitis media from others is the fact that the perforation is accompanied with no pain. Only at a late stage of the disease, and especially in those cases where there is a mixed infection, do we have pain, and here the clinical history differs but slightly from an ordinary suppurative inflammation of the middle ear. It is by no means an easy matter to make a diagnosis, for it must not be assumed that even in a case of general tuberculosis the ear trouble is due to the presence of the tubercle bacillus, for this can be true only when we find the organism in cultures made from the tympanic cavity. What is especially characteristic of tuberculous otitis media is the presence of two or more perforations, for we know this is exceptional with otitis media due to other causes. Facial paralysis is another distinguishing feature of tuberculous otitis media.

TREATMENT. When the author comes to discuss treatment he suggests nothing which promises any measure of success. When advanced tuberculosis of other organs exists we can do nothing more than treat the local symptoms, and we do this best by frequent irrigation of the external auditory canal; in other words, by cleanliness. When the patient is apparently strong and there are no suspicious symptoms of a general tuberculosis, resort may be had to surgical procedures, and this is to be done in the manner laid down by von Bergmann and Stacke. After such an operation it is always best to leave the wound open. It may be mentioned, in conclusion, that von Lucie, Bezold, Schwabach, and others have employed tuberculin, but it cannot be said that any special benefit followed, and there is more than one case reported where the condition became worse after its use.

PROGNOSIS. It is evident that the prognosis in the primary form of the disease is comparatively favorable. Though tuberculosis of the middle ear has long been recognized, and its symptoms for the most part accurately described, it does not seem that the subject has ever received the attention it deserves. Winkler has brought out points which scarcely find mention in the majority of text-books.

Pulmonary tuberculosis is a very common disease, yet how seldom do we see coincident infection of the middle ear. The large majority of inflammations of the middle ear originate in infectious processes in the pharynx, such as we have in measles and scarlet fever. We know that the conditions for the extension of infection up the Eustachian tube in pulmonary and laryngeal tuberculosis are exceptionally favorable, and we cannot help wondering why the middle ear is exceptionally involved.

Perforation of the Drum Membrane. Miot¹ has given us some interesting details of his treatment of perforations of the drum mem-

¹ Archives de Laryngologie, May and June, 1898.

brane. Before attempting to close a perforation it is necessary to ascertain whether the substitution of tissue for the hole will not diminish the hearing. This can be satisfactorily determined by inserting an artificial drum. If the hearing is improved by this measure we can be reasonably certain that benefit will follow the closure of the perforation. The success of this method depends largely upon the condition of the edges of the perforation, for if the latter are much indurated we are less likely to obtain a closure. Miot does not think that the existence of a permanent discharge contraindicates the operation, though he thinks it best to wait until all inflammatory symptoms have subsided. Cocaine anaesthesia is employed, and, ordinarily, from four to ten days should elapse between the applications. Great care should be taken to touch only the borders of the opening, and if the acid does not produce prompt reaction the edges should be touched with the galvano-cautery. Inasmuch as this new-formed tissue may be ruptured at the moment of forced expiration, it is well to reinforce this area with a thin layer of cotton. The author has treated 51 perforations in this manner, and his results are as follows: Complete cicatrization occurred in 47 cases; deafness was aggravated in 2 cases, and in 2 cases, where cicatrization failed to take place, the hearing remained unchanged; in 47 cases the hearing was satisfactory.

Stricture of the Eustachian Tube. Ducl¹ again calls attention to the value of electrolysis in treating strictures of the Eustachian tube. It seems that the method has not been generally followed by improvement, and Ducl thinks that this is probably due to the fact either that unsuitable cases were selected or that the electricity was not properly used. The cases where this method seems peculiarly applicable are where there is decided narrowing or complete stenosis of the tube, occurring in chronic tubal catarrh or in connection with chronic aural catarrh. In such cases Ducl thinks that we can almost certainly promise relief from the tinnitus, and frequently improvement in hearing. Where there is labyrinthian disease, or in residual purulent cases accompanied by a narrow tube, the results are not nearly so good, but the operation is none the less justifiable. It is absolutely necessary that a reliable milliamperemeter should be used to measure the current strength, and that a rheostat be employed to enable the operator to control the amount. Ordinarily twenty to fifty volts will be sufficient. When the tube is so much stenosed that no air is heard to enter the tympanum on inflation, no attempt should be made to pass the bougie until we are certain that the tip of the catheter is in the Eustachian orifice. A gold bougie should be used. After passing the bougie up to the point of the constriction and turning the current on, no attempt should be made to push through

¹ The Laryngoscope, February, 1898.

the constriction too rapidly, as it takes a minute or two for the latter to soften. The best way is to press the bougie gently against the constriction, turning on a current of from 1 to 5 milliamperes, if necessary. After using the bougie it is best to wait two days, and then inflate, and to repeat the inflation every two or three days. At the end of a week, if no improvement is noticed in the patency of the tube, it should be bougied again. We should not resort to a larger bougie so long as improvement continues as a result of the first operation. The author thinks that once well opened the tubes will remain so indefinitely. Ducl's report is an exceedingly interesting one, and if his further experiments are confirmatory, the value of his contribution cannot be overestimated.

Sclerosis of the Middle Ear. At the last meeting of the British Medical Association, Dundas Grant presented a paper on "Mechanical Vibration Applied to the Spine in the Treatment of Sclerosis of the Middle Ear."¹ He had observed that certain persons who heard better in the midst of a noise heard better also when riding on bicycles. The improvement, of course, was due to mechanical vibration, and this agency Grant has employed in treating sclerosis of the middle ear. At first he used a vibrating helmet (Gilles de la Tourette), which was placed on the patient's spine. For greater convenience, however, he made use of a small motor, on the axle of which was fixed a disk of brass in an eccentric position. On one side of the motor was attached a flattened curved band of metal, like a hand-blotted, and on the other a handle like that of a teapot. An electric current sets the instrument in motion, and application is made directly to the spine of the patient between the shoulders. It should be felt in the head and ears, but should be held as low down as is compatible with this effect, so that the acoustic stimulation may be as slight as possible. The application is made daily for a week, after which its frequency is diminished.

The cases which Grant reports may be put in that class which is usually not benefited by inflation or other tubal treatment, and which is characterized by tuning-fork evidence of middle-ear catarrh, gradual in onset and free from any considerable narrowing of the Eustachian tube. He reports ten cases of this character; in eight improvement followed the treatment, and in three of these eight the improvement was very striking. It is the opinion of Grant that the good effect produced is due to an indirect massage of the stapedio-vestibular joint.

Thyroid Treatment. Since the introduction of the thyroid treatment its efficacy has been tried on many a field, so to speak. Vulpius, Brühl, and others have already administered thyroid extract in cases of middle-ear disease when there was more or less loss of ossicular mobility, and

¹ British Medical Journal, October 22, 1898.

not a few communications have been made in favor of this method of treating certain forms of ear trouble. Macleod Yearsley¹ has made a number of clinical experiments to control the results of others, and in his hands the results were absolutely negative. Fifteen cases were sclerosis of the middle ear, three were non-suppurative middle-ear catarrh with ossicular ankylosis, and three were ossicular ankylosis due to middle-ear suppuration. Most of the cases were under treatment from six to eight weeks, and in no single case did any benefit ensue from the treatment, some, on the contrary, retrogressing. These negative results are, of course, valuable, and would seem to indicate that the remedy is practically valueless in affections of the ear.

The Value of the Pressure Sound. Lucæ² calls attention once more to the value of the pressure sound in certain affections of the ear. He shows that the effect produced upon the entire chain of ossicles is different from that seen in any form of atmospheric massage. In order to demonstrate the character of the effect produced, he stuck a needle into the head of the stapes, and on the other end fastened a minute blade of straw. The result was that every time pressure was made the piece of straw would make a decided movement inward, and would return to its former position as soon as the pressure was removed. The movement somewhat resembled that seen with Siegel's otoscope, but the effect is more far reaching, in that it shoves in the entire chain of ossicles with their ligaments. It follows from this that the pressure sound is only applicable to those cases where there is very little rigidity in the articulations of the ossicles; where, in other words, it is still possible to stretch the ligamentous connections—cases, for instance, where the whisper can be heard from 1.5 to 2.0 m., or where there is still relatively good perception of high musical tones. Lucæ then describes a modification of this instrument, which he regards as a valuable addition to the armamentarium of the otologist. It may be said, in conclusion, that this method of treatment has been often witnessed by the reviewer in the hands of others well known on the Continent; but, after following the cases closely, it was not clear that in the long run any better results were obtained than when pneumatic massage was employed.

THE INTERNAL EAR.

Pathology. The veil which hides pathological processes in the labyrinth has seldom been lifted high enough to allow much light to be thrown upon them. Experimental pathology in this field has not been taken up with enthusiasm, and a contribution of this character would be

¹ Loc. cit.

² Archiv für Ohrenheilkunde, Bd. lxiv. Heft 4.

regarded as something almost new. Matte¹ has endeavored to give us a better insight into the pathology of labyrinthian disease by a number of experiments upon animals, usually dogs, rabbits, and mice. Inflammation was set up in the labyrinth, and the effects of this inflammation were studied not only in their bearing upon the labyrinth itself, but upon the adjacent parts—*i. e.*, the skull and tympanic cavity. Mechanical and chemical means were employed to produce this inflammation. Under the first head small particles of cotton or metal were introduced into the labyrinth, and under the other head sterilized croton oil, cocaine, strychnine, and atropine. The effects of certain bacteria were also observed, as, for instance, of the staphylococci, streptococci, and the bacillus coli communis. These organisms were introduced into the labyrinth, and the effects of each were observed. The experiment was usually made on one labyrinth, the other remaining untouched, so that the normal and pathological could be studied side by side. In order to study the changes in the brain, central nervous system, and tympanic cavity in their bearing upon processes in the labyrinth, serial sections were made of the brain in its entirety. His results are interesting and are worth relating.

The bony labyrinth was carefully opened, and into the opening a drop of croton oil was introduced by means of a Pravaz syringe. The behavior of the animal after such an application depended more or less upon the exact point where the application was made and the quantity and strength of the application. For example, when the application was made to the ampulla in the case of pigeons, violent disturbances in coördination were immediately seen; when an injection was made into the cochlea, the disturbances did not manifest themselves so promptly; but when they did appear, it was with great intensity. One case was rather striking. Immediately after the injection of several drops of croton oil the pigeon flew across the room, but on trying this again it would always turn a somersault, and finally there would be noticed spasmodic movements of the head toward the operated side; the disturbances in coördination increased in intensity, and in a day or two the bird was unable to fly.

The author then describes the macroscopical condition, which is of no special interest; not so, however, with the microscopical condition. The spaces in the labyrinth were filled with coagulated lymph, with here and there a few leucocytes. The bloodvessels were enormously distended, especially the veins of the aqueductus cochlea leading toward the brain, and at this point there were large masses of exudate. These changes could be traced along the nerve-trunks into the brain. The changes in

¹ Loc. cit.

the nerves which were particularly noticeable were to be seen in their perfection in the cochlea and ampulla, and consisted in a complete disappearance of the neural epithelium, while the supporting fibres were still to be seen. Hemorrhages were also present at these points, and a free exudate was lying in the subdural space. The changes described as present in another animal, sixteen days after an injection, differed in no essential points from those seen in the first experiment.

It is well to note the fact, however, that the tympanic cavity on both sides participated in the changes, the process spreading, no doubt, through the numerous pneumatic spaces. The mucous membrane was much swollen, and the epithelium could hardly be recognized, owing probably to the necrosis. The condition of the bloodvessels was similar to that found in the labyrinth, and identical changes were found in the pneumatic spaces. This participation of the tympanic cavity of the non-operated side was not so marked in the second experiment. After the injection of cocaine, strychnine, or atropine, pretty much the same clinical symptoms were observed. This was also true of those cases where cultures of bacteria were injected. What was very remarkable in all these cases was the new formation of bone in the place of the soft parts removed. After the removal of the entire soft parts in the labyrinth the denuded areas would be filled up with new bone formation.

Determination of One-sided Deafness. One of the most interesting and important communications of the past year is by Bezold,¹ of Munich, on this subject. As to whether an ear without a cochlea can hear has long been the subject of controversy, and Bezold's investigations have undoubtedly given us proof which goes to show conclusively that an ear without a labyrinth has no independent hearing power. His conclusions are based for the most part upon the clinical observation of eleven cases of labyrinth necrosis which came under his own eye. It would seem from statistics that necrosis of the labyrinth is a very rare affection, and it is probably the severest one which attacks the ear. The process follows chronic inflammation of the middle ear of many years' standing. There is often a destruction of the bony parts of the labyrinth, followed by destruction and loss of function of the soft parts, and these are the cases which afford us "opportunities for determining how much an ear can hear without its labyrinth."

Generally the cochlea is the structure most liable to necrosis, and there are two ways by which the suppurative process reaches this part of the ear—first, by a coincident inflammation of the small cells at the base of the tympanum and the commencement of the Eustachian canal, and, secondly, by a perforation into the cochlea after rupture of the delicate

¹ Archives of Otology, April, 1898.

membrane of the round window. It is rather a remarkable fact that the formation of sequestra is apt to be more extensive in early life than later on. It has been supposed by many that there was a peculiar predisposition in children to necrosis of the labyrinth, but the observations of Bezold show that in his experience adults are affected as often as children. It is not likely that the tuberculous process is concerned in the development of necrosis of the labyrinth, for while it is well known that necrotic processes are very common in the final stage of an otitis media purulenta, still, as Bezold observes, "a real casting off of the parts of the labyrinth is very rare."

Vertigo, tinnitus, and vomiting are frequently seen, appearing early in the history of the labyrinth affection, and disappearing usually with the extrusion of the sequestrum. The appearance of these symptoms may be regarded as an indication that the middle-ear process has reached the labyrinth. Facial paralysis occurs in over 80 per cent. of cases, and indicates a commencing loosening of the sequestrum. Pain is a constant symptom felt at first in the entire half of the head, but later on it becomes confined more to the ear. The discharge becomes more profuse than usual, and is very fetid.

The treatment consists chiefly in cleanliness and in the removal of granulations. Forceful extraction of the sequestrum before it is loose is not advisable. It is interesting to learn that involvement of the mastoid is rare in this affection.

There are some who maintain that hearing is not entirely abolished in cases where parts only of the labyrinth have been destroyed. Bezold thinks this is an erroneous view, and that it may be accounted for by the fact that it is impossible to exclude the other ear from the act of hearing, and in this opinion he is upheld by Bee, von Stein, and others. If we had opportunities of studying the conditions in bilateral labyrinth necrosis we would be in a position to decide this question. Max and Gruber reported two cases of this character, but they were both totally deaf. It does not seem possible to obtain evidence of a remnant of hearing which can be referred to the ear with the defective labyrinth.

As regards the examination of this class of cases, Bezold has shown that the true condition is better revealed by the use of clear tones in testing than by speech, for in the latter case our results are often exactly the reverse of what we would expect. In the same way it is almost impossible to exclude the healthy ear in tests made with the tuning-fork on the skull. Bezold concludes, then, that the *aërotympanic* tests are the only ones which give us conclusive proof of the hearing power in the affected ear. We have first, he says, to determine the lower and upper limits in the tones which are perceived and the duration of hearing a number of sounds within the perceived portion of the scale. As regards

the lower limit, this was determined by forks of his former tone-series, and also with forks of Edelmann's series.

He analyzes these tests in the most instructive manner. He shows how difficult it is to exclude the good ear from hearing so great a force of sound as was produced by the experiments. It is significant that below the *a* of Edelmann's series, which is heard by a normal ear at a distance of several metres, not a single tone was heard. The upper tone limit was determined by the modified Edelmann-Galton whistle. He shows that this limit varies a great deal at the lower end of the scale; but as we go below the upper limit of the normal ear it is impossible to exclude the healthy ear. The duration of hearing was determined with unclamped tuning-forks, and with one exception all of the ears with defective labyrinths showed similarity in their preserved ranges of hearing, from *a''* or *a'* upward. In those cases where the other ear was normal there was found a continuous increase of the hearing duration from the lowest to the highest tones within the hearing range. The author then proceeds to show that all these results are not what we would naturally expect, and that they could all be accounted for by imperfect exclusion of the hearing ear. If we go over the tests made of those ears with defective labyrinths it will be seen that they simply reflect the hearing condition of sound ears. This exhaustive demonstration of Bezold's should be regarded as probably the most valuable contribution which has yet been made to this chapter of otology.

Injuries of the Internal Ear. Injuries of the internal ear do not present suggestive objective symptoms, and the discovery of an objective symptom which is characteristic of lesions in this locality is a decided gain for otology. While Müller¹ has given us an interesting analysis of such cases, some thirty in all, it cannot be said that he has shown us an easy way to make a diagnosis, from the objective point of view, of injuries of the internal ear. This aspect of the subject is still more or less unreliable. His patients had all received head injuries of various kinds, and they had complained of symptoms which strongly suggested a lesion in the internal ear. These symptoms were chiefly headache, deafness, noises, etc., symptoms which, in the absence of external injury of any kind, pointed to the internal ear as the seat of the lesion. Müller tells us that in at least half of his cases he found a demonstrable objective symptom which was of the greatest value in confirming the diagnosis. In these cases he observed that the inner end of the external auditory canal was slightly hyperemic, and that this condition was present on the tympanic membrane, producing at this latter point a general cloudiness of the membrane and an irregularity and blurred appearance

¹ Deutsche med. Wochenschr., August 4, 1898.

of the light reflex. The injection was slight, most marked at the upper periphery and in the region of the malleus handle, and sometimes the vessels passed from the canal right over on the membrane. The membrane as a whole suggested the condition of chronic thickening.

The author points out the difference between hyperemia here and that seen in inflammatory processes due to other causes. In the former case the redness has a bluish tinge, and this shade becomes more pronounced with time. It may be said here that many of these cases were seen years after the injury, and none of the subjective symptoms of an acute inflammation had ever been present. Such symptoms as he points out mean pathological changes not only in the labyrinth, but also in the trunk of the acoustic nerve, and even in the brain itself. The author refers to the observations of Schwartz and others, and to the experiments of Koch and Filchne, all of which go to show that in such cases as his the concussion produces a paralysis of the vasomotor nerves in the brain, and this is followed, of course, by disturbances in the circulation, manifested chiefly by increased intralabyrinthian pressure and by hyperemia of the entire nervous apparatus of the ear as far back as the brain, and involving the latter. In the same way we may have this condition of hyperemia produced in the tympanic membrane, external auditory canal, and adjacent parts. When we observe this condition in an individual who has suffered an injury to the head, and who has long complained of vertigo, noises, headache, and deafness, we may suspect a similar degree of hyperemia in the labyrinth and in certain parts of the brain.

THE EXTERNAL EAR.

No doubt the obstinacy of furunculosis in this locality is due to the difficulty of disinfecting the canal. No sooner does the abscess rupture than the entire canal is covered with pyogenic bacteria, many of which it is very difficult, if not impossible, to remove. Haug,¹ of Munich, strongly advocates the use of alcohol in such cases. He introduces into the ear strips of gauze soaked in alcohol, and then closes the meatus. The strips are changed four or five times in the twenty-four hours. The results of this treatment were, as a rule, remarkably good, and particularly so as an abortive measure. Even in cases where the abscess had a start of several days, the effect of the treatment was to hasten the formation of the abscess, at the same time making it more circumscribed. Generally the pain was lessened in the first few hours of the treatment, and in no case did the application of the alcohol produce pain.

¹ Archiv für Ohrenheilkunde, Bd. lxx. Hefte 1 u. 2, S. 127.

CERUMEN. Lannois and Martz¹ have given us the results of a most interesting chemical analysis of cerumen. With the exception of the analysis made by Pétrequin and Chevalier, no important contribution on this subject has appeared. We all know that cerumen gets only a word or two in the text-books, and the exhaustive experiments of Lannois and Martz will undoubtedly prove a valuable source of information. The principal constituents of cerumen are water, free fatty acids, fats, cholesterol, soaps soluble in alcohol and urea, substances soluble in hot and cold water, insoluble substances, etc. The various reactions resulting from treating cerumen with alcohol, ether, and water are minutely described. What is said of the coloring matter of cerumen is interesting. The pigment is yellow, closely analogous to the pigment of the human fat, but it is less soluble in ether than the latter, though quite soluble in alcohol. As to the bitter principle contained in cerumen, it is present in both aqueous and alcoholic solutions. In an alcoholic solution with the reaction of Udransky one would suppose that there were biliary acids present. It is a question whether the bitterness of cerumen may not be due to the presence of cholalic acid.

The conclusions of the authors are as follows: The fatty matters soluble in alcohol and ether constitute more than one-third of dry cerumen. Especial attention is called to the large quantity of soaps which are soluble in alcohol and also to the large proportion of cholesterol. The lecithin, which is so frequently found in the organism, exists in not inconsiderable proportion in cerumen. The pigment is analogous to that of the human fat, though less soluble than the latter in ether. Cerumen probably contains leucomaines. The exact nature of the bitter principle is undetermined further than that it somewhat resembles an acid and is soluble in water.

MISCELLANEOUS.

The Effects of Compressed Air. Over a year ago some investigations were made by Alt, Heller, Mayer, and von Schrötter to determine the nature of ear diseases which are produced by compressed air. It will be remembered that these investigators found that the peculiar changes occur as a result of two causes—the inadjustable pressure difference without and within the ear, and gas emboli due to too rapid diminution of pressure. The latter cause is productive of the worse changes. A series of somewhat similar investigations has recently been made by Lester and Gomez.² The importance of selecting sensible, and, so to speak, matter-of-fact, individuals upon whom to observe the effects of

¹ *Revue Internat. de Rhinologie, Otolologie, etc.*, March, 1898.

² *Archives of Otolology*, vol. xxvii. No. 1.

experiments of this character, is self-evident. In the first place, it takes not a little determination to pass through such an experience, and to properly interpret one's sensations requires both a sound mind and body. The dimensions of the caisson in which the experiments were made were as follows: Length, 76 feet; breadth, 60 feet; depth, 8 feet. It was found that the compressed air in the receiving tank had a remarkably high temperature, about 148° F., while in the caisson proper the temperature was about 70° F. The entrance of the compressed air was productive of a number of sensations varying with the idiosyncrasies of the patient or, rather, subject. One of the experimenters, who had in early life sustained a fracture of the inferior maxillary bone, experienced an acute lancinating pain in this region, which pain, however, disappeared when the pressure was equalized. Fullness in both ears was almost always felt, and as the pressure increased a pushing in of the tympanic membrane was felt, a sensation which was only relieved by practising the Valsalva method. None of the party experienced either pain or vertigo. Violent tinnitus was usually present. These symptoms disappeared on entering the caisson proper. It might be said, too, in passing, that marked disturbances in the general circulation were noted, for while the average radial pulse before entering the caisson was 76 a minute, on leaving it was 120. Among the striking phenomena noted on entering the caisson were the peculiar pitch and intensity of the voice and autophony. It was difficult to speak and impossible to whistle the higher notes. These same symptoms were experienced to a less marked degree on leaving the caisson. On the completion of the experiment, muscular fatigue and depression were felt for quite a time. The hearing distance for watch, speech, and whisper were determined by actual measurement.

The conclusions of these observers are as follows: The reaction of the tuning-forks is markedly diminished for aerial and bone conduction, and this is especially true of the higher notes. Bone conduction is affected to a greater degree than aerial conduction. This is probably due to hyperaesthesia of the labyrinth or to some analogous disturbance, the effects of which are more pronounced on the lower portion of the cochlea. The hearing power for both aerial and bone conduction is reduced directly in proportion to the atmospheric pressure. The lower tone limit is unaffected. Weber's test was negative in all the cases, both before and after entering the caisson, while in the latter the hearing distance for whisper, speech, and watch was much diminished.

The effects of these labyrinthian disturbances persist from twenty-four to forty-eight hours. Depression of the drum membrane may be produced by one-half an atmosphere, while a pressure of two atmospheres will bring about a congestion of the malleolar plexus and of the membrana flaccida, sometimes leading to displacement of the ossicular chain

and persistent tinnitus. Persons suffering with coryza or congestion of the naso-pharyngeal mucous membrane must not enter the caisson, and this precaution is equally applicable to those who have been in the habit of entering and re-entering caissons for years. Persons affected with middle-ear disease or with labyrinthian disease should be cautioned against entering the caisson, and this holds good for those who have a weakened or diseased circulatory apparatus.

Education of Deaf-mutes. At the last meeting of the German Otological Society the subject of the education of deaf-mutes was introduced by Passow, of Heidelberg. It has been known for several years that the number of totally deaf among children in deaf-and-dumb institutions is not so great as it was once supposed to be. Remains of hearing are not infrequently found, and such patients learn to speak more readily than those who are entirely deaf. This being the case, it is of the greatest importance that careful examinations be made of children in such institutions, and an estimate made in each case of how much, if any, hearing there be present. Bezold has done much for this class of individuals, and thinks the possibilities here, by systematic practice in hearing and speaking, are great.

Urbantschitsch thinks that almost all deaf-mute children can be helped to a certain extent by such exercises, and that, in addition to this method of exercise, practice in tones should also be employed, believing, as he does, that the irritation to which the nerves of hearing are exposed by this procedure is of decided benefit to the hearing. Bezold, however, has shown that the limits of tone perception, even in children who are apparently improved by the exercises, remains the same. Attention was called to the fact that not infrequently children are admitted to these institutions who have remediable ear troubles, such, for instance, as those originating in adenoid vegetations. It is of the highest importance to have connected with every such institution an aurist, whose duties it shall be to make a careful examination of all the inmates and to pick out those who have traces of hearing, and to build upon this trace. In the discussion which followed, Bezold stated that out of eighty pupils in the deaf-and-dumb asylum in Munich, since the adoption of this rule seventeen had been found who had traces of hearing, and were being trained on this basis. Bezold further said that the children who were suited for this method of training could be selected with absolute certainty by the aid of the continuous tone series.

Malformations of the Ear. Under this head Stetter¹ has given us a long essay on the congenital and acquired malformations of the ear.

¹ Die Angeborenen und Erworbenen Missbildungen des Ohres, von Prof. Dr. Stetter, in Jena. Verlag von Gustav Fischer, 1898.

The author commences his monograph by cursorily reviewing some facts relating to the embryology of the ear going to show that congenital malformations of the ear occur, for the most part, in the earliest stages of fetal life, in which case malposition of the ovum no doubt figures largely as a factor. It must be said, however, that even in a later stage such abnormalities may occur, and it is well known that they may have a post-natal origin.

Stetter speaks first of absence of the auricle, an exceedingly rare condition, only four cases having been reported. Deviations from the normal in the shape of the auricle are not infrequently seen, and many such cases have been placed on record. It may be mentioned here that Gradenigo¹ has observed that anomalies in the shape of the auricle are more often found in those with mental defects and in criminals, and the same observer has found that one-sided anomalies are more often seen on the right side. Stetter mentions interesting facts in connection with outstanding ears and the probable cause of this condition. His suggestions as to treatment are well known. Some rare cases of macrotia and microtia are mentioned. One of the latter class is reported by Stetter where the auricles in a woman of thirty-five years were correspondingly small. The author speaks quite fully of the various deviations from the normal of different parts of the auricle, as, for instance, an enormous tragus or antitragus, peculiarities in the shape of the helix, etc., suggestions presented by the ears of some of the lower animals, coloboma of the ear, and the various reports on this latter condition by Virchow, Meckel, Loeffler, and others. Virchow first called attention to a condition which might be called polyotia, where it appears as though there were a reduplication of the auricle. Casselholm reports a case of this kind where the child had two ears in the usual position and two, just below, on the neck. Somewhat similar cases are reported by Birket and Fielitz, and are to be traced, according to Virchow, to an irregular closure of the fetal cleft. Stetter refers to a number of cases of the so-called auricular appendages, reported by Barth, Haug, and Max Schultze. Hensinger was the first to observe, or rather to describe, congenital fistula of the ear, a relatively frequent anomaly.

Congenital malformations of the ear passages are rare unless associated with anomalies of the auricle. A number of cases of atresia of the canal are mentioned, and in this connection the author emphasizes the futility of all known methods to establish a canal. Schwartz, von Tröltzsch, Haug, and Lincke have reported cases where the external auditory canal was narrowed to the diameter of 0.5 mm. Complete absence of the drum membrane has rarely been observed. A case was reported by Elsasser in

¹ Archiv für Ohrenheilkunde, Band xxx, S. 232.

1828. In this case the greater part of both drum membranes was lacking. It is evident that there is some difficulty in diagnosing congenital defects of the drum membrane, for not infrequently defects occur in this membrane in the earlier weeks of the infant's existence, and this might readily lead us to conclude that we had a congenital condition. A case of this character, but which admits of some doubt, is reported by v. Tröltseh.

As regards congenital malformations of the ossicles, reference should be made to the contribution of Lüneke on this subject.

Congenital anomalies of the muscles of the middle ear and of the Eustachian tube are exceedingly rare. Of importance are the malformations of the labyrinth and of the acoustic nerve, and here heredity certainly plays an important rôle in the etiology. Entire absence of the labyrinth has been observed a number of times, such cases having been reported by Moos, Steinbrügge, and Lüneke. Valsalva found an instance, in a case of miscarriage, where the exit of the acoustic nerve was closed.

ACQUIRED MALFORMATIONS. In this class belong, first, those deformities which result from cicatricial contraction. Interesting facts are mentioned showing the malformations of the auricles produced in certain countries by the wearing of ornaments. Narrowing of the lumen of the canal is a not infrequent condition, and we all know the causes which usually lead to it. Mention is made of the atresia of the canal of old people due, v. Tröltseh thinks, to a relaxed condition of the fibrous tissue in the canal. Abnormally large external auditory canals are reported by Urbantschitsch. Malformations on the drum membrane are well known, and are due to causes familiar to us all. Stetter ends his valuable and interesting contribution with some remarks upon congenital and acquired deafness.

Deafness Due to Syphilis. The onset of inherited syphilitic deafness is but little dwelt upon in the text-books, and a description of this stage of the affection has recently been furnished us by Pritchard and Cheate.¹ The authors recognize two forms of onset in inherited syphilitic deafness—one, without giddiness, which runs a chronic or subacute course, and where the auditory nerve and its terminals are chiefly affected, while the equilibration mechanism is intact. Here we have a periostitic or ostitic thickening. In the other form we have *giddiness*, which may run an acute, subacute, or chronic course. The whole of the labyrinthine nerve endings are involved, and we probably have an exudate which causes increased tension and, as a consequence, the giddiness. The deafness in the acute form is due to destruction by pressure of the labyrinthine nerve endings. In the subacute and chronic cases the deafness is due to a

¹ Archives of Otolaryngology, October, 1898.

constantly recurring increase of tension and to changes in the exudation itself acting on the labyrinthine nerve endings.

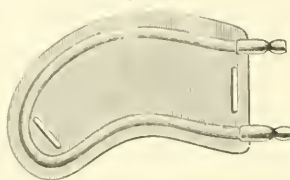
Deafness Due to Nephritis. According to Morf,¹ Dicaufey was the first to call attention to the frequent association of deafness with chronic nephritis. Morf has collected fifty-three cases out of the literature, which, with three of his own observation, make fifty-six cases. The author divides the aural changes due to nephritis into two groups. The first group includes only affections of the middle and internal ear, such as can be revealed by either functional or objective examination, while in the second group no tissue changes can be found to account for the functional disturbance. The middle-ear diseases are present in three forms: inflammatory, inflammatory-hemorrhagic, and hemorrhagic. Where the otitis assumes the purulent form there is an unusual tendency to necrosis and caries of the surrounding bony walls in the temporal bones. Hemorrhages are usually very abundant and occur in the middle-ear spaces. Hemorrhage into the labyrinth has not yet been demonstrated. No satisfactory explanation has been given of the second group of cases—that is to say, of those cases where neither otoscopic nor functional examination gives us a clue to the seat of the affection. The theory of increased arterial pressure within the labyrinth falls far short of explaining this group of cases. According to the author, Rosenstein first suggested that the deafness might be due to edema of the auditory tracts, and it seems that this interpretation is probably the correct one, for it is borne out by the investigations of Morf and others.

Sometimes the deafness and albumin may be the only symptoms of nephritis present, and, when this is the case, we are probably dealing with chronic uremia. The statistics would indicate that disturbances in hearing occur in about 50 per cent. of nephritic cases. The usual auditory symptoms are subjective noises and deafness, auditory hyperæsthesia being observed in one case. The ear may become affected at any stage of the nephritis, though it usually follows an exacerbation of the kidney trouble, in the form of diminished urine, increase of the albumin, and the appearance of uremia. The subsequent course of the aural lesion is influenced by the kidney trouble. According to French writers, the ear becomes affected which is on the side where the facial edema is most marked. As regards the second group of cases, localization, Morf thinks, is impossible. Most of the facts would indicate that we have an affection of the auditory nerve end and its distributions. Finally, the ear trouble is to be regarded as a complication which can be of grave import, especially when we have the purulent form. Hemorrhages are always ominous, as they are usually followed by death. The affections of the first group generally recover while those of the second leave sequelæ.

¹ Loc. cit.

Modified Leiter Apparatus. Gomperz¹ has suggested a modification of the well-known apparatus of Leiter. As we know, the original apparatus is rather heavy, and the cold is distributed to unnecessary parts.

FIG. 28.



A modification of the Leiter coil for the application of cold (or heat) to the mastoid region.

This defect frequently causes rheumatic pains. As modified by Gomperz, the apparatus is much lighter and covers simply the region of the mastoid process, and is clear of the auricle.

Detection of Malingerers. Warnecke² adds another test to those already existing for the detection of simulation. The method consists in examining the malingerer with two examiners, and with the whisper. One examiner is placed at the distance at which the patient pretends to be able to hear, while the other is placed a few metres further away. The eyes of the patient are closed and the ear which is turned away from the examiner is stopped up. If the patient hears the whispered numbers or words put to him by the nearer examiner, or, we may say, examiner No. 1, then examiner No. 2 takes up the test. If it be necessary for the latter to increase or to lessen his distance from the patient, it should be done with the greatest caution—that is to say, without attracting the patient's attention. We can do this generally by diverting his attention by noises. In many cases examiner No. 2 would begin his test at the maximum distance of 13 m., in order to avoid moving forward and backward, and thus possibly endangering the success of the experiment. If the patient says he only hears whispered speech from examiner No. 1 when the latter is close up to his ear, then examiner No. 1 should (after making the patient repeat the whispered words after him) give a sign to examiner No. 2, who will begin to whisper while examiner No. 1 will keep up the deception by breathing on the ear without phonation.

Recent Literature. An American author, Gorham Bacon, has made a recent contribution to otology in the shape of a text-book. It shows its kinship to what has emanated from the same writer (*System of Surgery*, Dennis), but in this form the story is more attractive reading

¹ Illustr. Monatschr. der aerztl. Polytechnik, February, 1898.

² Archiv für Ohrenheilkunde, Band. xlv. Hefte 3 u. 4.

and the lessons which it teaches are of more value. In glancing over the library of a medical student it will be found, usually, that every branch of medicine except otology is represented by a text-book, and the chief reason for this is that most works on otology are written for the otologist and not for the student. This is a mistake from more than a business point of view, for even the otologist wearies of long dissertations and would gladly find less toilsome roads to knowledge. Bacon's work is conspicuously practical, and is good reading not only for the student but also for those who have long been workers in this field of medicine. It is a much less voluminous work than many others on the same subject, though none of the essentials are omitted. Here and there are points on which issue might be taken with the author, as, for instance, the advice to make an "early incision in the drumhead" in the treatment of acute purulent otitis media, and, again, the rather free use of chromic acid as a caustic (when such an action is necessary), as in granulations in the middle ear in chronic purulent otitis media. It is no uncommon thing to have the most acute inflammatory symptoms follow such an application, for, unlike nitrate of silver, chromic acid destroys not only what it is meant to destroy, but spreads to healthy parts and thus acts as an irritant; there seems to be no way of limiting the area of its activity. The author's advice, however, is exceptionally safe throughout, and the chapters on Diseases of the Mastoid Process and Intracranial Complications are admirable. The work is a useful addition to otology.

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
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